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Developed by educators, professional foresters, employers, and U.S. Office of Education personnel, this curriculum guides was designed to assist school administrators, advisory committees, supervisors, and teachers in planning and developing new programs or evaluating existing programs in forest technology. The content includes sections on: (1) The Technician's Work, Education, and Opportunities, (2) General Program Considerations, (3) Faculty, (4) Student Selection and Services, (5) Forest Land, Laboratory Equipment, and Facilities, (6) Textbooks, References, and Visual Aids, (7) Scientific and Technical Societies and Associations, (8) Advisory Committees and Services, (9) The Curriculum, (10) Course Outlines, (11) The Library, (12) Facilities, Equipment, and Cost, and (13) Bibliography. Outlines are included for 12 technical courses, three mathematics and science courses, five supporting technical courses, and four general courses. The appendix includes a selected list of organizations and associations pertinent to the education of forest technicians. This is a revision of ED 021 063. (DM)

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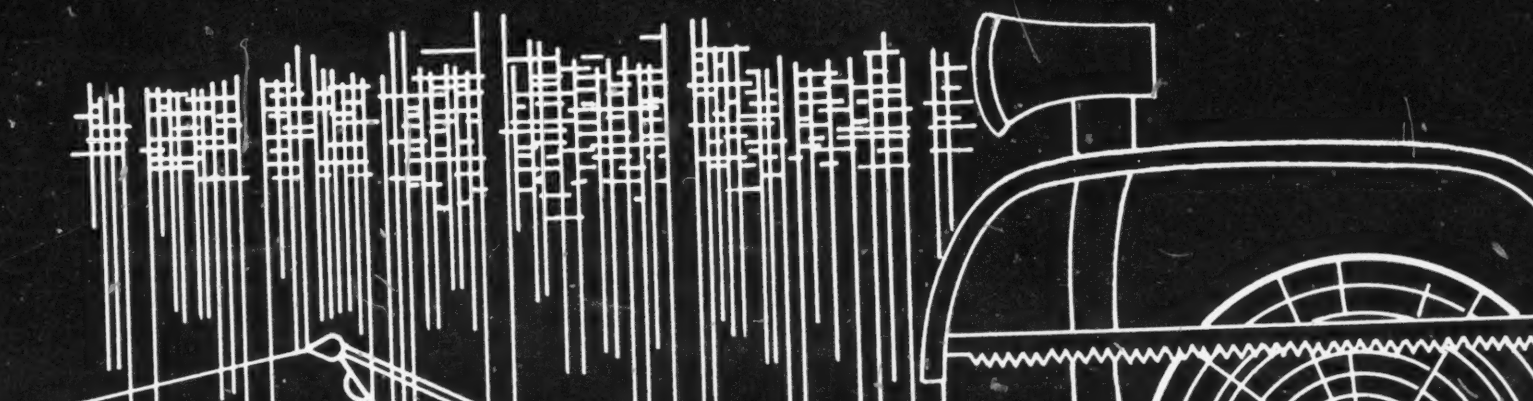
Forest Technology

A Suggested 2-Year Post High School Curriculum



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OE-80054

FOREST TECHNOLOGY

A Suggested 2-Year Post High School Curriculum

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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FOREWORD

THERE IS a serious shortage of the highly qualified technicians required to assist professional foresters in all phases of forest culture and utilization. This suggested curriculum was prepared to assist the States and other interested organizations and institutions in planning, and developing programs to meet the Nation's increasing need for qualified forest technicians.

The guide suggests course outlines with examples of texts and references, sequence of technical education procedure, forest land requirements, laboratory layouts with equipment and cost, discussion of special library, faculty, and student services, and a selected list of scientific, trade, and technical societies. It is designed to assist school administrators, advisory committees, supervisors, and teachers who will be planning and developing new programs or evaluating existing programs in forest technology. Although the indicated level of instruction is post high school, the sequence of course work may start at any grade level where students have the prerequisite background and understanding.

This guide was developed by agricultural and technical education specialists in the Division of Vocational and Technical Education, U.S. Office of Education. The basic materials were prepared by the Thompson School, University of New Hampshire, at Durham, New Hampshire, pursuant to a contract with the Office of Education.

Many useful suggestions were received from special consultants, advisers, and owners and employers in the forest and forest products industries, and from administrators and teachers in schools of technology. Although all suggestions could not be incorporated, each was considered carefully in the light of the publication's intended use. Therefore, it should not be inferred that the curriculum is completely endorsed by any one institution, agency, or person. It is a plan for a program; a plan to be modified by administrators and their advisers to meet local, State, and regional needs.

GRANT VENN
Associate Commissioner
Adult, Vocational, and Library Programs

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Mount Hood Community
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Mount San Antonio College
Walnut, Calif.

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Coeur D'Alene, Idaho

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Rocklin, Calif.

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State Education Department
Bureau of Agricultural
  Education
Albany, N.Y.

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THE TECHNICIAN'S WORK, EDUCATION, AND OPPORTUNITIES

RAPID TECHNOLOGICAL changes in the culture, protection and harvesting of our Nation's forests involving use of highly specialized and efficient labor saving machines and the application of complex and sophisticated scientific developments in forest management have created a serious shortage of highly trained forest technicians to assist professional foresters in all phases of forest culture and utilization.

Increasing awareness of the importance and value of the Nation's forest resource is indicated by the acreage of State owned forest lands in some regions, particularly the northeastern States; and the systematic acquisition of large areas of land for scientific forest production by private enterprises in other regions, especially in the southern States. These activities increase the requirements for professional foresters and for skilled technicians to assist them in their work of managing the Nation's forest resources.

Although the principles of forestry have been known and practiced for over 60 years in the United States, it has only recently become evident that forestry is experiencing the same technological growth as other fields. The increase in applied technology in the forest resource management field, and the passage of the Land and Water Conservation Fund Act in 1963, have produced a need for more and better trained technicians. Population growth has increased the recreational use and potential of forests. Competition among companies to produce better products in a shorter time requires better educated personnel. Local, State, and national efforts to conserve forests and other natural resources have increased the requirements for trained manpower. As a result, the forest technician is in greater demand now than ever before.

There has been a growing concern among foresters about the present and future manpower needs for management and efficient use of forest lands and other natural resources. Various reports (too numerous to mention here) have demonstrated the need and demand for greater depth in formal training and informal on-the-job training.

It has been widely recognized that forestry always has required and probably will continue to require a large amount of technical work in the area between the skilled workman and the professional forester. This technical work has been done by a combination of professional foresters, students working toward professional degrees, rangers, and other persons with or without formal training but with practical woods experience and on-the-job training.[1]

The forest technician works under the general supervision of the professional forest manager, scientist, ecologist, or biologist—supporting him, supplementing him, and

FIGURE 1.—Culture, care, and conservation of forest resources is a growing field of technological employment. More and more technicians assist professional foresters in many ways. These student technicians are examining the cone crop for forest management purposes.

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[1] H. W. Blenis, *The Indispensable Forest Technician,* Washington, D.C.: 1962, pp. 651–653.

freeing him for more duties requiring truly professional or scientific judgments.

The following definition may be helpful in describing a forest technician:

"The forest technician is a person competent to occupy a responsible position in the line of authority between the skilled forest worker and the professional forester. He may direct the activities of the former under the supervision of the latter and must apply in a responsible manner proven techniques which are recognized as being professionally sound. The techniques employed demand acquired experience and knowledge of forestry, combined with the ability to work out the details of a task in the light of well established practice.

"The forest technician differs from the semi-skilled worker (aide) in his knowledge of forestry theory and methods and from the forester in his more limited or specialized background and in his use of technical skills in support of forestry activities. The senior (advanced) forest technician occupies the area between the skilled forest worker and the forester at the end of the spectrum closest to the professional forester. The forest technician requires an education and training sufficient to enable him to understand the reasons for, and the purposes of, the operations for which he is responsible. He should understand technical terms and appreciate the professional point of view. The forest technician does not need either the depth or extent of scientific understanding required of a

FIGURE 2.—A forest technology program must own a forest area, or control one by long term lease, and manage it for educational purposes if it is to be a realistic program. The area should be no more than an hour's drive from the school, and large enough for significant forestry activities. Additional public or private forest lands should be available for study, survey, inventory, and observation of management.

forester, but he does need a practical working knowledge of the same subject matter." [2]

The forest technician must be capable of working and communicating directly with forest engineers, professional foresters, and scientists as well as the production personnel in his area of work; he must satisfactorily perform work for his employer and also show potential for growing into positions of increasing responsibility. Some forest technicians perform manipulative skills, while others supervise the application of such skills. Most do both. Their work is distinguished from that of the skilled worker primarily in that it is less repetitive, involves more objective analysis and problem solving, and requires an understanding of the principles of science, engineering, mathematics, and statistics in addition to their own particular technical skills in forestry. The graduate forest technician should be an active, well informed member of his community and of society as a whole.

Any program which, when mastered, will produce the type of graduate described above, must be carefully designed. Each course must be planned to develop the student's knowledge and skills in his particular area and be directly integrated into the course of study. The sequence of courses is specially constructed to contribute uniquely toward the final objective of producing a competent forest technician. If close correlation of courses making up the curriculum is not

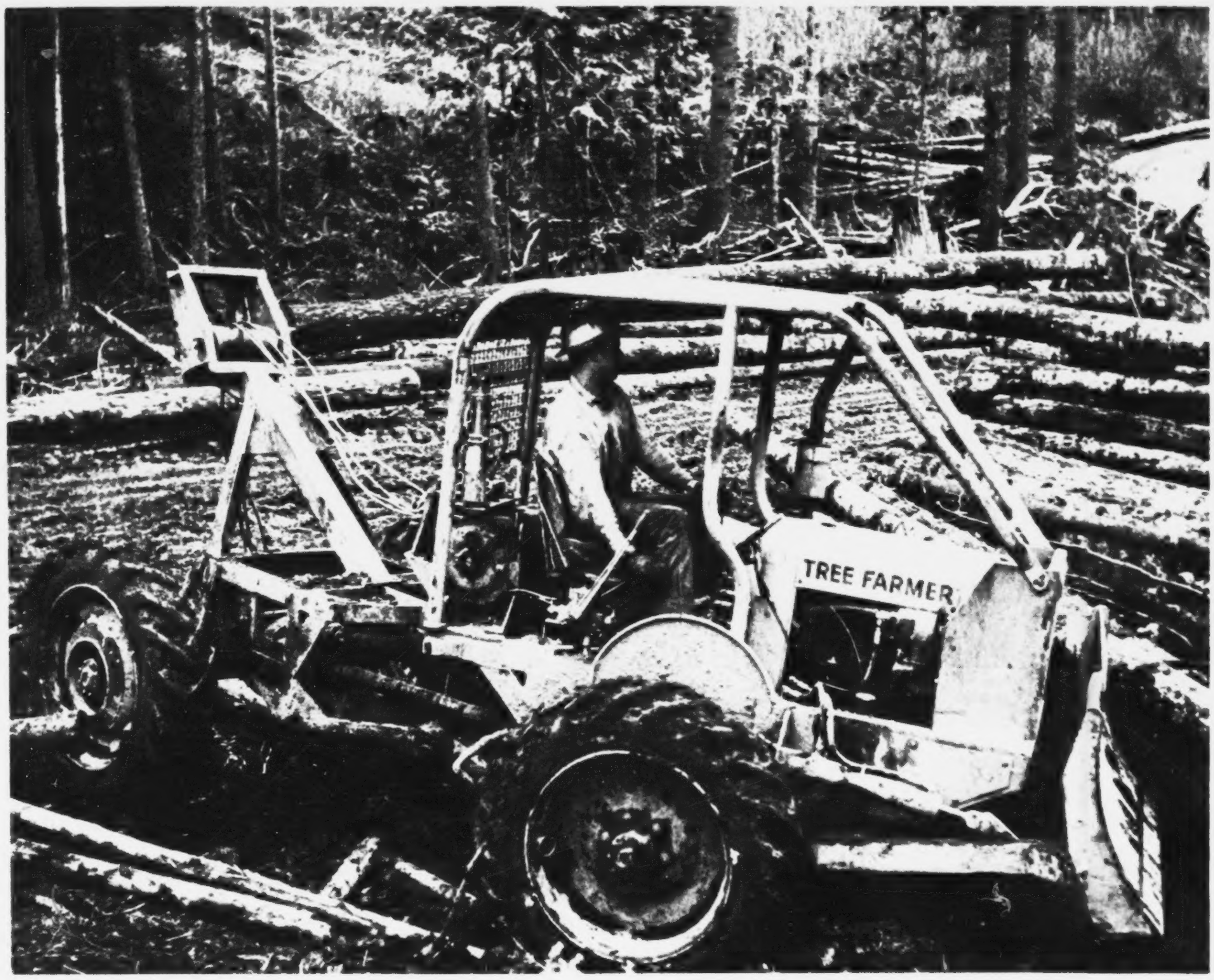

FIGURE 3.—Modern machinery for forest culture and harvesting must be understood by forest technicians. Note the difference between the machine shown here for work in small, second growth timber and the loading machine shown in Figure 2.

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[2] Society of American Foresters. *Forest Technician Training Programs in the United States—A Progress Report.* Journal of Forestry, Vol. 65 (7): 484–487, Washington, D.C., 1967.

maintained, the program cannot provide the depth of understanding required of modern forest technicians.

The technical content of the program is intended to supply a wide background in the diverse areas of applied forestry. A firm foundation in basic forestry techniques and basic forestry activities is supplied in the first year, and the second year of work builds directly on this background.

Graduates of this program may be expected to find employment in many areas in the forestry field. Each of these areas may require somewhat different abilities and different specialized knowledge and skills for a successful career. Most of these different abilities will be acquired by continued study on the job or in part-time study to master the specifics of a specialized field. The following are some of the major areas or clusters of job opportunities for forest technicians as they are described by employers:

1. Research technicians: A technician working directly with scientists and professionals in developing new methods and operations, and in doing basic research.
2. Sales and service technicians: A technician representing a company and its product to a forest industry. He advises the customer and is capable of installing, operating, and trouble-shooting equipment and of training customer's personnel to service and maintain equipment located at the customer's installation.
3. Operations technician: The technician working in the field in either a public or private capacity. Working directly as a supervising foreman of field crews in many or all of the various operations assumed by an active natural resource manager.
4. Forest products buyer: A technician who specializes in buying wood or other forest products.

In addition to these major areas for graduates, there are numerous other areas in which the technician may work.

Some examples of occupational opportunities for which a graduate forest technician would be adequately prepared or which he could attain with experience follow. These may be found with Federal, State, or private forestry operations.

Timber stand improvement (field supervisor and manager)
Nursery culture work in forest nurseries
Assisting on lumber grading chain (trainees as professional graders)
Forest surveying—boundary problems, deed research, campground and pond layout, road location and reconnaissance, elevation, and drainage systems
Logging assisting on small woodlots and trainees for large logging sales company as engineers
Log and pulp scaling
Timber cruising and volume estimating (forest inventory)
Timber sale layout and marking
Timber buying
Small sawmill management
Kiln operation and scheduling
Fire control and assisting in presuppression and suppression activities
Forest insects and disease observations and control
Sales and service representative for wood products sales organizations
Park and recreation management of private and public campgrounds and parks
Company record manager and keepers for wood operations
Lineman and trimmer for tree companies working in the shade tree industries
General administration of a designated area within a State forest or park (State district forest ranger).

Forest technicians generally begin work as trainees or in relatively routine positions under the direct supervision of an experienced technician, scientist, or professional. As they gain experience they are given more staff responsibility, often carrying on a particular assignment under only general supervision. Technicians often move into supervisory positions. Some obtain additional formal training and are promoted to professional forestry positions.

Employment opportunities for forest technicians are expected to be attractive and to increase for the foreseeable future. In recent years, technicians have been one of the fastest growing occupational groups, and it is ex-

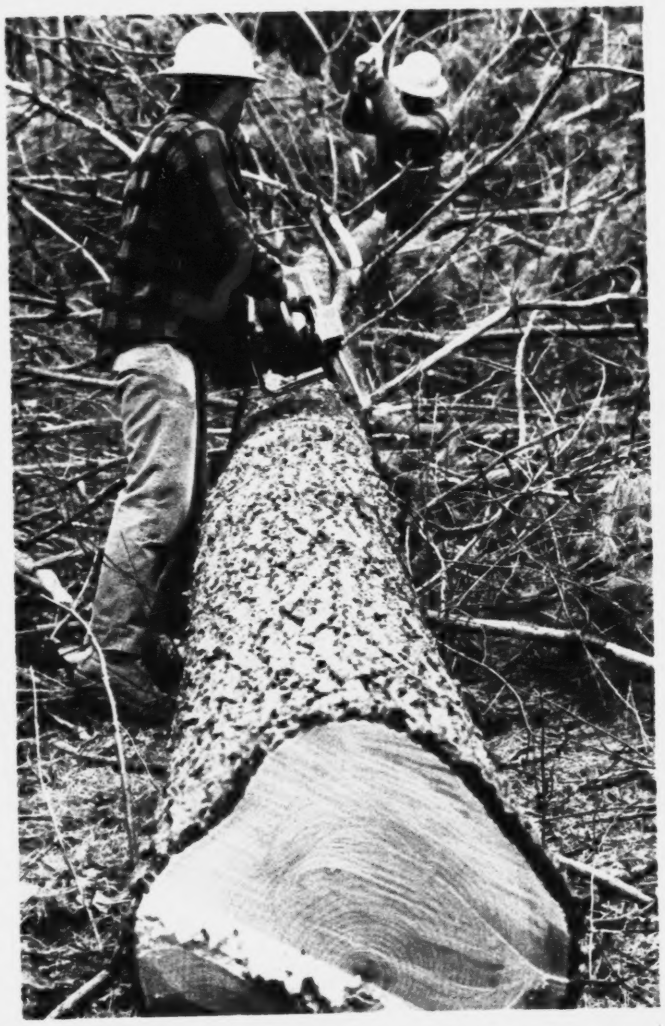

Figure 4.—The work of forest technicians includes a considerable variety of outdoor activities. These student technicians are learning the correct procedures for falling and bucking timber by doing it.

pected that this rapid growth will continue. In general, the demand will be strongest for graduates of a postsecondary technician training program to fill high level forest technician jobs. Growth of research and development expenditures is expected to create a greater demand for forest technicians. Such expenditures have increased rapidly in recent years and are expected to continue to rise through the mid 1970's, although somewhat more slowly than in the past. It is presently believed that the larger public agencies and private forest resource organizations require approximately 25 vocational aides to 15 technicians, 10 managers (professionals), and one scientist.[3] The above staffing ratio may vary somewhat from region to region.

There is general agreement on the need for more and better trained men for all four of these work areas. On the other hand, as in engineering and certain other fields, there is a widespread belief that there are far too many forestry schools turning out too many graduates who are neither the top quality technicians nor the top quality professionals that employers need and are willing to employ.

Assuming a ratio of two technicians to one professional and an intensity of forest resource management calling for one professional forester for every 20,000 acres of commercial forest lands and one professional forester for every 40,000 acres of non-commercial forest lands (Dean Henry J. Vaux's assumptions),[4] the number of forest professionals and non-professionals employed in 1966-67 and estimated as needed by 1980 are as follows:

	1966–67	1980 (estimated)
Scientists	3,000	4,100
Managers	10,000	17,000
Specialists	4,500	13,000
Technicians	12,000	24,000
Forest Aides	18,200	34,000

Over a 20-year period, based upon these assumptions, there is an indicated annual need for 620 technicians, about 390 of whom might be expected annually from 1-year certificate or 2-year associate degree programs, and about 230 annual full-time equivalents from bachelor of science degree students and locally experienced persons. It has been computed, based upon these assumptions, that production of forest technicians between 1961 and 1980 will increase by 557%. Scientists with doctoral degrees will increase by 100%; masters, 150%; bachelors, 67%; student trainees, 100%; and aides, 81%.[5]

Twenty-one forest technician training pro-

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[3] Peter W. Fletcher, J. L. George and R. E. McDermott, *Training Technicians and Professionals for Natural Resources Management*, U.S. Department of the Interior: Resource Publication No. 30, pages 21–49.

[4] S. T. Dana and E. W. Johnson, *Forestry Education in America Today and Tomorrow*, Washington, D.C.: Society of American Foresters, 1963.

[5] See Footnote 3.

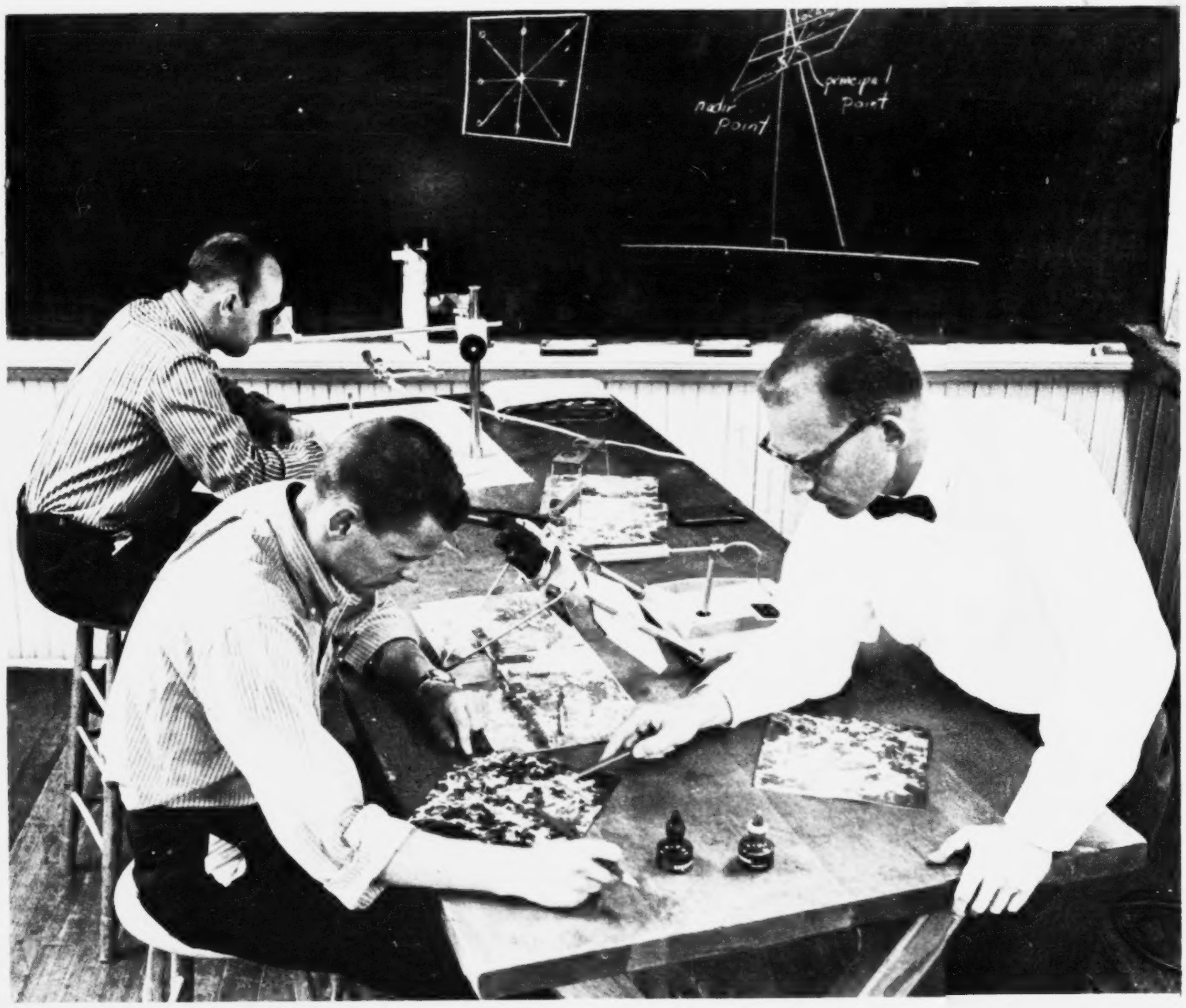

FIGURE 5.—Photogrammetric interpretation is a necessary technological skill for forest technicians as they assist in silvicultural inventory, survey, and other forest management activities.

grams graduate 435 men a year. This compares with about 1,650 persons who graduate annually with bachelor of science degrees in forestry and related fields from 47 collegiate institutions.[6]

The United States is formally preparing about 3.9 professional foresters to one technician, whereas Canada is formally preparing about 3.3 technicians to one professional.[7] Industrial and Federal personnel in forest management in the United States have expressed the belief that three or four formally trained forest technicians should be educated for every professional forester in the future.

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[6] Gordon Markworth, *Statistics from Schools of Forestry for 1967*. Journal of Forestry, 65:265–271, 1967.

[7] H. W. Blendis, "The Maritime Forest Ranger School and Its Place in Canadian Forestry Education." Paper presented at the Annual Meeting of the New England Section, Society of American Foresters, Boston, Massachusetts, 1965.

GENERAL PROGRAM CONSIDERATIONS

The objective of the total program discussed in this guide is to produce a competent forest technician capable of entering any of a number of employment opportunities in forestry or in closely related work.

Because forest technicians are employed in numerous and often specialized situations, the adequately trained technician must have attained the following abilities, scientific knowledge, and technical skills:

1. Facility with mathematics: The ability to use algebra and basic trigonometry as tools in the development of ideas that make use of scientific principles related to forestry. A basic knowledge of statistical methods is required.
2. Proficiency in the application of scientific principles, including the basic concepts and laws of physics and biology which are pertinent to forest technology.
3. An understanding of the materials, processes, and techniques commonly used in the technology.
4. An extensive knowledge of a field of specialization with an understanding of the scientific activities that distinguish the technology of the field.
5. Communications skills that include the ability to interpret, analyze, and transmit facts and ideas graphically, orally, and in writing.

The forest technician will use the foregoing abilities, knowledges, and skills as he performs several (but usually not all) of the following general activities:

1. Applies knowledge of science and mathematics extensively in rendering direct technical assistance to scientists and professionals engaged in scientific research and experimentation.
2. Designs, develops, or plans modifications of new products, processes, or programs under the supervision of professional personnel in applied research, design, and development.
3. Plans production as a member of the management unit responsible for the efficient use of manpower, materials, and machines in production.
4. Advises, plans, and assists in estimating costs as a field representative of a manufacturer or distributor of a technical equipment and/or product.
5. Prepares or interprets basic engineering drawings and sketches as they pertain to his specific technology.
6. Selects, compiles, and uses technical information from references such as engineering standards, forestry handbooks, and technical digests of research findings.
7. Analyzes and interprets information obtained from precision measuring and recording instruments and makes evaluations upon which technical decisions will be based.
8. Analyzes and diagnoses technical problems that involve independent decisions.
9. Performs day-to-day supervision of forest production, and prepares field and office reports.
10. Performs routine administrative duties such as cooperating with people in the administration of public and private forest lands.
11. Conducts training sessions for field crews in fire control, planting, or other pertinent activities.
12. Deals with a variety of technical problems involving many factors and variables that require an understanding of several technical fields.[8]

A 2-year program must concentrate on primary or fundamental needs if it is to prepare individuals for responsible technical positions in forestry. It must be practical in its approach and must involve a high order of specialization.

The program suggested in this bulletin has been designed to provide the maximum technical instruction in the time that is scheduled. To those who are not familiar with this type

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[8] Adapted from *Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs*, OE 80015, Washington, D.C.: U.S. Government Printing Office, Superintendent of Documents, 1962, page 5.

Figure 6.—Accurate scaling and grading of timber is only one of many important field responsibilities often delegated to forest technicians in growing, protecting, inventorying, harvesting, and marketing forest products.

of educational service (or the goals and interests of the students who elect it), a technical program often appears to be inordinately rigid and restricted. While modifications may be necessary to meet local requirements, the basic structure and content of this curriculum should be maintained.

The technical program has the usually recognizable five subject matter divisions, namely: (1) specialized courses in the technology (forestry); (2) auxiliary or supporting technical courses (such as technical report writing and forest technology seminars); (3) mathematics courses; (4) science courses (such as soils and botany courses); and (5) general education courses. The technical subjects provide application of scientific and forestry principles. *For this reason, mathematics and science courses must be coordinated carefully with technical courses at all stages of the program.* This coordination is accomplished by scheduling mathematics, science, and technical courses concurrently during the first two terms—a program principle that will be illustrated at several points. General education courses constitute a relatively small part of the total program. It has been found that students who enter a technical program do so because of the depth in the field of specialization that the program provides. Many students who elect this type of education program will bring to it a good background of general study.

Figure 7.—Skill in the use of such scientific instruments as shown in this biological laboratory is another necessary element in the education of forest technicians. Laboratories must be large enough to provide work experience for all students and be equipped with up-to-date apparatus similar to that in current use in the industry.

High quality is a mandatory requirement for a successful technician education program. An adequate forest area, a competently trained teaching staff, well equipped laboratories with apparatus representative of that used in the most modern forest industries, a good library, adequate classrooms, and an administration sincerely dedicated to quality occupational education are essential. It normally takes a minimum of 5 years and many thousands of dollars to establish a new program, assemble a staff, equip facilities, and graduate the first class or two. When these graduates are successfully employed and confidently advertising their success to their peers and parents, the program is well established since successful employment of graduates indicates acceptance by the professional leadership in the field, which is a major key to success of the program.

A poor program, on the other hand, is by far the most expensive of all. It costs as many dollars, wastes the time and the effort of the students and the staff, and worst of all, disappoints future employers and disillusions students and their parents.

The study and planning which must be done by a school before it decides to start a forest technology program is of the utmost importance. A complete study must be made of the present and predictable future employment opportunities and need for forest technicians in the region served or servable by the institution. This study should include information from employers, professional forestry consultants, public agencies involved in forestry or employment of foresters, labor and employment agencies and statisticians, and any other sources of reliable and pertinent information which will define whether or not there is a real and continuing need for the program.

Affirmative answers to many questions should be assured before the decision is made to offer a new program even if the need for it has been definitely established. The following are some of the most important:

1. Is adequate forest land available to be owned or leased on a long time basis for the program?
2. Can a well qualified faculty be obtained?
3. Will suitable space for classrooms, laboratories, and shops be available?
4. Can tools, instruments, and specialized equipment of high quality be provided in sufficient quantity?
5. Will the budget permit expenditures for replacement of worn out and obsolete equipment?
6. Can coordinating, placement, and guidance services be provided?
7. Are students with the necessary potential ability and interest available in sufficient numbers?
8. Will all these factors result in a program which will satisfy student and community needs at a reasonable unit cost?
9. Will the program have the active support of local, State, and regional employers, forest agencies, and professional forestry personnel?
10. Will the program be needed for at least 10 years or more?

FIGURE 8.—These forest technician students are discussing the physical characteristics of big game specimens as a part of their study of wildlife ecology in forests.

FACULTY

The effectiveness of the program depends largely upon the competence and the enthusiasm of the teaching staff. The specialized nature of the curriculum requires that the instructors of forestry subjects have special competencies based upon proficiency in technical subject matter and professional forestry experience.

Beyond this an instructor of forest technology must understand the educational philosophy, the objectives, and the unique organizational requirements that characterize technical education programs. Instruction in the technical education program is not a matter of conducting independent classes in separate subjects; all courses must be closely interrelated.

To be most effective, members of the faculty responsible for this program must have interests and capabilities which transcend their area of specialization. *All* of the faculty members should be reasonably well oriented in the requirements for study in the forest sciences and their application so that they may use forestry examples or subject matter as supporting materials in teaching their respective courses. For example, if the communications courses are to be of maximum value, the teacher should be familiar with the communications problems and demands placed upon forest technology personnel. Without such a background, the communications course may not offer the support that is needed in the total program of education for the technician. Similarly, various scientific principles may be taught in courses in mathematics and measurements, with the respective course instructors emphasizing and illustrating how the principles are utilized in forestry design and application.

Teachers of specialized technical subjects require advanced professional training and should have had professional experience in their field. All instructors should have had some formal instruction in teaching. Professional forestry graduates who have acquired suitable professional experience and who have continued their practical education often become excellent teachers. Similarly, technicians with years of experience who have become professional foresters are especially qualified to teach. People with these backgrounds are more likely to understand the objectives and unique instructional requirements of technical education. Furthermore, individuals with this particular background often bring to the program enthusiasm and an appreciation of the values of technical education—characteristics which are essential to the success of any educational program. Instructors should be licensed if licensure is a common practice in their specialty area.

Since programs for teaching highly skilled technicians must be a series of well integrated courses if the scope and depth of training is to be adequate, careful consideration must be given to when and at what level a new concept is to be introduced. This may be accomplished through "team teaching." In this sense, team teaching is the organization of a technical staff into a coordinated teaching unit. The teaching assignments are made on the basis of the individual member's special training and talent. Concurrent courses are closely coordinated by team members to utilize the student's time effectively while he is moved smoothly through progressively higher levels of understanding.

Team teaching can only be developed and nourished by the teaching faculty. A weekly departmental staff meeting to encourage the development of team teaching is recommended. At these meetings each instructor should check with instructors of concurrent courses to insure that close coordination is being maintained. This is especially important with new courses and new techniques. If less than optimum coordination is evident, the important factors can be analyzed by those involved in order to find a solution to the problems.

In addition to keeping concurrent courses well coordinated, staff meetings provide for free exchange of ideas on teaching techniques discovered to be useful and on recently developed laboratory projects which seem to be particularly successful. Any project which seems especially interesting and beneficial to the student should be analyzed to see if the same principles of presentation can be employed in developing other projects. Special attention should be given to any scientific or technical journal articles that may improve the teaching of a subject area or which present new information which should be taught.

To help keep a staff effective, its members should be encouraged to participate as active members in professional and technical societies. Through these media they can keep up with the newest literature in the field and maintain close liaison with employers of technicians and other leaders in the field by meeting or attending meetings addressed by the leading specialists in the field. Encouragement of instructional staff self-development is increasingly being provided by technical school administrators in the form of released time and financial assistance to attend society meetings and special technical teacher-training institutes. Periodical sabbatical leaves should be offered to allow staff members the opportunity to increase and update their professional experience by other employment or further study. To serve as consultants in their professional field also encourages faculty development and excellence.

When determining teaching loads for instructors of technical specialty courses, consideration must be given to the number of student contact hours required by their schedules. Fully effective teachers in a special area of education require considerably more time to develop courses and laboratory materials than do shop instructors or teachers of general education courses. A contact or work load of 15 to 20 hours per week usually constitutes a full teaching load for any technical specialty teacher. The rest of the time should be spent in assisting students, in course development, and in developing effective laboratory experiments and field exercises. If administrative duties are assigned to instructors, proportional reduction of the teaching load is indicated.

Class size must be considered in developing effective teaching since individual attention is recognized as a vital element in the technical programs. The maximum size of a lecture class may vary somewhat depending on the material to be covered, the lecture room size, and the teaching technique used; but for most blackboard lecturing, classes of between 20 and 30 students usually should be considered the optimum. If little or no class discussion is attendant to the lecture, the size of the class may be significantly increased by use of overhead projection of carefully prepared notes on the lecture which would normally be written on blackboards for a smaller class.

Careful planning of laboratory teaching schedules is important. Laboratory and field sections should not be overloaded with students. Effective teaching can not be accomplished if there are too many students per work group. If too many students try to work on the same project, most of them will not benefit because they are unable to participate sufficiently in doing the work themselves. In the forestry field, optimum group size is generally two or three. A desirable student-faculty ratio is 10–15:1 under field conditions, depending upon the nature of the course.

Technical programs are designed to produce support personnel who increase the effectiveness of operating teams. This principle of support personnel may be employed to increase the effectiveness of the teaching staff. Staff assistants may be used in stock control to set out the proper equipment for laboratory classes, to keep equipment operating properly, to fabricate training aids, and to do a limited amount of routine paper grading. This allows the teaching staff to devote considerably more time to course material development, to the preparation of handouts to supplement lecture material, and to insuring that the necessary components or experimental materials are functioning properly and available when needed. Most of the support personnel may be graduate technicians, graduate assistants from other institutions, or equivalently trained and experienced personnel.

Five teaching staff members is a minimum requirement for a post secondary school forest technology program, assuming appropriate enrollment in each course throughout both years of the program and also assuming single sections and classes. If the program were large enough to have more than one section of first-year or second-year students, proportionally more teaching staff would be needed. One staff member should be designated head of the program. His responsibilities usually include, among other duties, program supervision, forest land management, budget administration, placement responsibilities, and public relations in addition to a part-time teaching load. Two additional technical specialty instructors are also required plus the full-time equivalent of two instructors to teach communications, mathematics, and other subjects which are not in the technical specialty group.

Additional supporting staff should include a custodian for the buildings and one secretary-typist. An increase in teaching personnel would require a commensurate increase in secretarial assistance.

STUDENT SELECTION AND SERVICES

While the effectiveness of a technical education program depends greatly upon the quality of the faculty, the program's ultimate objective is to produce high quality graduates. It is essential, therefore, that the students accepted into the program have certain capabilities. If the incoming student's background is inadequate, the instructors will tend to compromise the course work to allow for his inadequacies, with the probable result that the program will be inadequate in depth and scope.

Students entering the forest technician program should have comparable educational backgrounds and capabilities and should exhibit some evidence of maturity and seriousness of purpose; otherwise, the program may never reach its objectives. Applicants who have demonstrated their competence and ability through previous field experience, and have the other required prerequisites for entrance, should receive priority consideration in enrollment. Wide ranges of ability among students can create an inefficient teaching situation, thereby preventing progress of the program at the necessary rate. The amount of material to be presented and the principles to be mastered require students who are not only well prepared in course material but also have the ambition, desire, and will to master a difficult program and to develop their capabilities to the utmost.

This program is designed primarily for high school graduates or equivalent who have particular abilities and interests. In general, students entering this program should have completed 2 years of high school mathematics including algebra and geometry, and 1 year of the physical sciences, with laboratory study in either chemistry or physics (preferably physics). If a student enters the program without adequate preparation, he will usually fail. Thus the program cannot accomplish the desired preparation of a highly capable technician, and to that extent the program is defeated. If applicants for admission do not have the necessary mathematics, science, or language skills, they should expect to take remedial work before entering the program.

Many institutions which offer programs for educating technicians provide *pretechnical*[9] programs up to a full year's duration to give promising but underprepared students the opportunity to enter a technical program of their choice with a good probability of successfully completing it. A pretechnical program helps to solve student recruitment problems, provides some insurance for high quality of graduates by starting with adequately prepared students, and gives promising students an opportunity to educate themselves to meet the Nation's urgent needs for technicians.

Student selection policies and practices should follow the best selective procedures known to the institution when the forest technician program is started. Improvement in selection of students for the program usually must be dependent on experience in the school because there are no proven selective tests or devices for forest technology at present.

Girls whose interests and scholastic preparation attract them to this type of program may be encouraged by the employment opportunities for women in forestry research and related work. The aptitudes and abilities for women with scientific interest and training particularly suit them for much of the analysis and related laboratory work in many forest research and manufacturing or allied institutions employing scientists.

Some employers encourage promising young people in their organization to become technicians and even pay part of the cost. The employer who encourages a field man to go to a forest technician program usually improves both the employee and his own enterprise. Such an employee has previously demonstrated knowledge and interest in the field of forestry and is probably more highly motivated than most students, having the ultimate objectives of graduating and moving back into the ranks of forest workers.

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[9] U.S. Department of Health, Education and Welfare, Office of Education. *Pretechnical Post High School Programs, A Suggested Guide.* OE–80049, Washington: Superintendent of Documents, U.S. Government Printing Office, 1967.

Forest technology graduates must be able to produce. They must be given broad and intensive experience in their class, laboratory, and field work. In addition to the classroom and field learning and practice, some kind of actual experience on the job is vital. This may be provided by obtaining employment in the industry during the summer between the first and second years, and at peak seasonal periods. It is important that students work in some phase or phases of the broad field of forest operations where they get on-the-job occupational experience that will enrich the second year of formal instruction. Such experience should include the writing of a detailed report on the summer work. Employment experience assists the students in obtaining employment after graduation. To employ student technicians is of great benefit to the employer because he can thus get seasonal employees, and also get acquainted with students he might wish to employ permanently after they graduate.

Effective guidance and counseling is essential. Students should be aided in selecting educational and occupational objectives consistent with their interests and aptitudes. Whenever possible, institutions offering technical education programs should consider the use of standardized or special tests to assist in student selection, placement, and guidance. A student should be advised to alter his educational objectives if it becomes apparent that he is more suited to other programs, either by reason of lack of interest in the technical program or lack of ability to satisfactorily complete the program.

Students should have counseling services available to them both before and after registration and enrollment in classes. General counseling is usually done by the school counselors, but much specific counseling is done by the forestry technology staff, both formally and informally throughout the entire program.

The new student should be quickly familiarized with the facilities on the campus and particularly should be given a tour of the library facilities and be made familiar with the procedures and rules governing the use of the library. If possible, organized field trips to nearby forestry operations should be arranged early in the program to give new students an opportunity to see forest technicians on the job. These tours might possibly strengthen the motivation of the student and perhaps point out why certain required subjects are important.

Forest technician student organizations may be formed to help bring together people with similar interests. The meeting of these organizations should provide exercise for the students in arranging their own programs. Speakers who represent employers in the forest industry or selected films may be used to stimulate interest at meetings and to broaden the educational aspects of forestry not taught in the classroom. Student organizations may assist with and participate in departmental activities such as career days and open house visitations.

Extra-curricular activities form a very valuable part of campus life. Students should be urged to participate in any activities supported by the institution for which they are eligible. Outing clubs, chorus, bands, science clubs, and other organizations are highly desirable for the total development of the student.

One of the clubs or organizations in a technical forestry program might be the Forestry and Wildlife Club, which should strive to establish an intimacy between forestry students and their faculty, and to enlighten other students in various forestry activities. The objective of the clubs could be a diversified program which might offer recreational and educational benefits. Typical activities might include the showing of films on the various fields of forestry, lectures by speakers from forest industries, outings consisting of woodmen's competitive field events, dances, parties, and various weekend trips such as hiking, canoeing, and snowshoeing in season. Club activities help the student to practice and improve his proficiency in making oral presentations, to use parliamentary procedure, and to gain poise and ability before a group or as a part of an organization. It is necessary to maintain a balance between the academic objective of the student and extra-curricular activity so that the educational endeavor is maintained in its proper primary position. The poorer students certainly cannot join in as many outside activities as can the better students.

Students should be given information concerning student membership in technical societies and be encouraged to avail themselves of the services and literature of such societies. Some professional societies offer an opportunity for the student to receive material of an excellent quality on a regular basis at nominal costs. After graduation the forest technician will continue to find regular reading of journal articles an important method of keeping his knowledge current in the field.

Academic achievements of students should be recognized in some manner. Many institutions grant an associate degree as tangible recognition of achievement upon graduation; some grant a certificate in technical forestry in addition to the associate degree. One function of a departmental club may be to make an annual presentation of an outstanding graduate award. Industrial organizations may contribute to offer an annual scholarship award.

Graduates of technical programs should be aided in every way possible in finding suitable employment. Placement personnel should be aware of the needs of employers of forest technicians and should acquaint prospective employers with the qualifications of graduates. The placement function is an extremely valuable service to the student, the institution, and the employer. In the final analysis, placement of graduates is an important responsibility directly or indirectly. An excellent placement record is very important in getting other students to enroll. In addition, the school should make periodic follow-up studies of the graduates to determine their progress and how their training aided them or was deficient. Many times this information can indicate how the curriculum or teaching techniques may be improved.

Placement is so important in the education of technicians that it should not be left to chance or to some agency outside the institution. The assistance of other placement agencies, public and private, will be helpful but the major placement effort should be centralized in one person or office at the institution. Employers who are recruiting technicians should be able to deal with one office. Placement records should be centralized where they may be kept up to date. The forest technology department head should be intimately associated with the placement program, if not in charge of placing the forest technicians. This keeps him in contact with employers and their needs.

Graduates of these programs move into relatively new occupational streams, where channels for job placement are not yet well established, therefore, the institution which educates them can usually best provide the necessary placement service.

FOREST LAND, LABORATORY EQUIPMENT, AND FACILITIES

Forest land which is owned by the institution or controlled by some long term lease arrangement and which is available for forest education field work and management is mandatory to the success of a forest technology program. The amount of such land may vary, but generally should include at least 2,000 acres of forested area. It must be located near enough to the institution's laboratory and classroom facilities to be within reasonable driving distance so it can serve as a field study laboratory daily throughout the year.

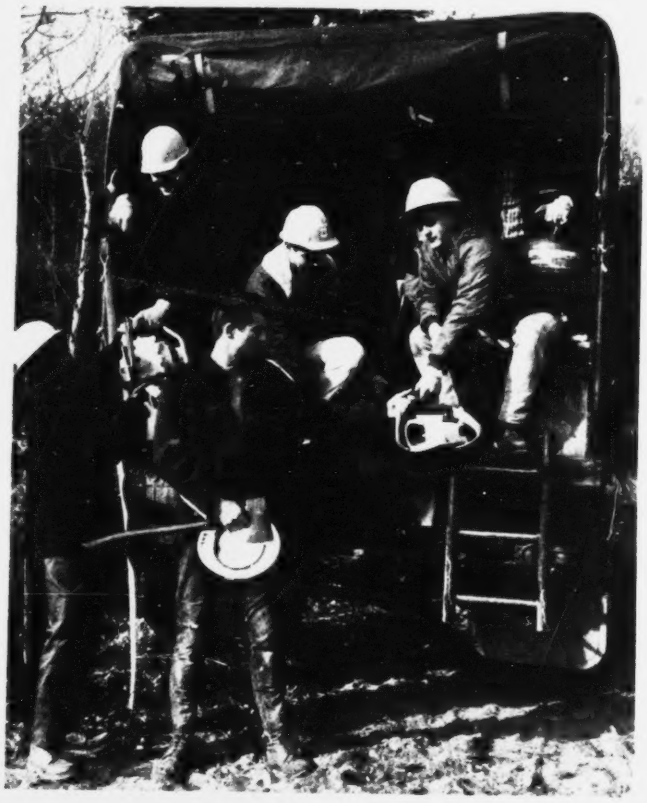

FIGURE 9.—Adequate and safe transportation equipment to get to and from field exercises is mandatory for any forest technician program.

Laboratories, equipment, and related facilities for teaching forest technician programs must be specially planned and adequately equipped to teach the technology. They must meet high standards of quality since the objectives and strengths of the program lie in providing valid laboratory and field experience, basic in nature, broad in variety, and intensive in practical experience. The training program must emphasize field experiences which illustrate the function and application of a wide variety of forestry equipment, and their use in representative application. Well equipped laboratories with sufficient facilities for all students to perform the laboratory work are required for these courses.

Laboratory and field equipment and facilities are a major element of the cost of such a program; they are indispensable if the training objectives are to be met. Equipment must be of good quality if laboratory and field work are to supply valid experience for the student. Inferior equipment may not show the principles being studied or may not be sensitive enough to provide reliable, precise data and may require unreasonable amounts of time and expense for repair and adjustment. The higher initial cost of high quality equipment is justifiable because the equipment lasts longer and makes possible laboratory experiments that give more precise results.

Selection of laboratory equipment should be made by the experienced instructional staff. The need for each item should be clearly established. Expensive apparatus may not always be required. Relatively inexpensive units can sometimes make the principles more evident because they present only the

FIGURE 10.—Desk calculators must be available in sufficient numbers when the students need them. They are required for computation in forest inventory determinations and many other related problems.

barest essentials. The number of units purchased, the particular areas of interest, the particular industry emphasis, and the ingenuity of the instructor(s) in adapting equipment to teaching needs will play a major part in governing the laboratory equipment which is selected and its cost. Throughout the program, emphasis should be on the *basic* principles which serve as the basis for so many forest management decisions.

Variety and quality of equipment and facilities such as land areas are more important than quantity in equipping laboratories for teaching forest technicians. Such equipment and facilities are indispensable if the training objectives are to be met. A separate section in this curriculum guide is devoted to equipment, facilities, and costs for teaching forestry technology in order to provide further suggestions in detail for such facilities.

TEXTBOOKS, REFERENCES, AND VISUAL AIDS

Textbooks, references, and visual aids for teaching any technology must constantly be reviewed and supplemented in light of (1) the rapid developments of new knowledge in the field, and (2) the results of research and methods of teaching and developing basic concepts in the physical and biological sciences, and mathematics. This is especially true in the forestry area. The impact of whole new areas of theoretical and applied scientific knowledge is demanding new textbooks, new references, new material in scientific and technical journals, and new visual aid materials.

New textbooks will reflect new methods of teaching scientific principles and applications as fast as current educational research becomes applicable. Extensive research and methods of teaching mathematics, management, mensuration, silvics, silviculture, statistics, and other disciplines in recent years almost certainly will produce changes in teaching materials and methods. It is therefore mandatory that instructors constantly review new texts, references, and visual aid materials as they become available, and adopt them when they are an improvement over those suggested here or presently being used.

The suggested texts and references listed for each course have been carefully selected; from the list presented it should be possible to select suitable texts if *newer* ones are not available. It should not be interpreted that unlisted books are not suitable. There are, no doubt, excellent ones which have not been included only because of lack of complete familiarity with them.

Before a department head or instructor undertakes a program in forest technology or any course contained in the curriculum, it is urged that he familiarize himself with the texts and references listed here and any new ones available. The instructor should also familiarize himself with "non-text" material such as publications available from experiment stations, pulp and paper companies, and State forestry organizations. He will then be in a position to select text materials which best serve his particular needs in providing a lucid, high level, technical presentation to his students.

Visual aids can be of great help in teaching programs. The aids which are listed in this guide have been selected from an extensive list and represent those considered most suitable at the time the curriculum was prepared. Again, there are many which are not listed because the variety and extent of the materials make an all-inclusive listing prohibitive. From those listed and others available and pertinent, an instructor may select those visual aids which meet his teaching objectives.

A recent increase in slide-tape programs has proven most useful in technical education programs. Instructors are urged to utilize these programs insofar as their programs permit.

In addition to the visual aids available for teaching the physical sciences and forestry principles, there are and probably will continue to be valuable films and other pertinent materials showing forestry research or production which should be used selectively in teaching forest technology.[10] Visual aids should *always* be previewed and analyzed for timeliness and pertinency before being used in a teaching situation.

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[10] N. T. Sampson, *Films and Filmstrips on Forestry*, Nacogdoches, Tex., 1965.

SCIENTIFIC AND TECHNICAL SOCIETIES AND ASSOCIATIONS

Scientific and technical societies[11] and trade associations are an important source of instructional materials and other benefits for faculty members and students. Such societies provide, through their publications and meetings, immediate reports and continuing discussion of new concepts, processes, techniques, and equipment in the sciences and their related technologies. Their presentation of scientific and technical discoveries and their interpretation of them explain the relationship of the theoretical scientist's work to the applied science practitioner's requirements. They are an invaluable aid in keeping abreast of new developments in a particular phase of science.

Less conspicuous, but extremely important, is the support which societies may give (1) in helping to develop evidence of need for a training program, (2) in helping to promote the program, (3) in enlisting members' support for the program, (4) in helping to provide work experience for students, and (5) in helping with the placement of graduates.

Associations and societies may supply resource people to speak to classes. They also may serve as hosts to student groups on field trips to study specific phases of the industry.

Instructors should be encouraged to become active members in these societies so that they may learn quickly of new technological developments. Membership will also enable them to meet people in the community who are most actively interested in the field. Some educational institutions pay all, or part, of the costs of membership dues and attendance at local or national meetings in order to encourage staff participation in selected societies.

Students of forest technology should be made aware of the literature and services of these societies early in their study program. Student subscriptions are offered by some of these societies, and students should be encouraged to avail themselves of the services of the societies to the fullest extent possible.

THE SOCIETY OF AMERICAN FORESTERS, Suite 300, 1010 16th Street N.W., Washington, D.C. 20036, is the largest and longest established professional society for foresters, with about 15,000 members at the present time. Its chief publications are the *Journal of Forestry* and *Forest Science.*

THE AMERICAN FORESTRY ASSOCIATION, 919 17th Street N.W., Washington, D.C., 20006, is an organization of conservation-minded citizens, foresters and laymen, numbering 40,000 members. It publishes *American Forests* monthly.

In addition to the two societies listed above, other technical forestry societies and associations are briefly described in the Appendix.

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[11] U.S. Department of Health, Education, and Welfare, Office of Education. *Scientific and Technical Societies Pertinent to the Education of Technicians.* OE–80037. Washington: U.S. Government Printing Office, Superintendent of Documents, 1965.

ADVISORY COMMITTEES AND SERVICES

The success of technician education programs depends, to a great extent, on the formal and informal support of advisory committees. When an institution decides to consider the advisability of initiating a particular technological program, the chief administrator or dean should appoint an advisory committee.

The special advisory committee for the Forest Technology Program should be comprised of representatives of employers and public employment services, scientific or technical societies and associations in the field, and knowledgeable civic leaders, who meet with and advise the specialists on the school's staff. Such members serve without pay, as interested citizens. They enjoy no legal status, but provide invaluable assistance. The committee normally consists of about 12 members (but may vary from 6 to 20), who generally serve for a 1- to 2-year period. The head of the institution or the department head of the technology is ordinarily chairman. It should be remembered that such people are always busy; therefore, meetings should be called only when committee action can best handle a specific task or problem.

The committee assists in surveying and defining the need for the technicians, the knowledge and skills they will require, employment opportunities, available student population, curriculum, faculty, laboratory facilities and equipment, cost and financing of the program. When the studies indicate that a program should be initiated, the committee's help in planning and implementing it is invaluable.

Frequently the committee gives substantial help to school administrators in obtaining local funds and securing State and Federal support for the program. When the graduates seek employment, the committee aids in placing them in jobs and in evaluating their performance. These evaluations often will result in minor modifications, which more closely relate the program to employment requirements.

The advisory committee can use this guide, designed primarily for planning and development of full-time preparatory programs in post secondary school institutions, as a starting point, modifying it to meet local needs. The program can also form the basis for courses to meet the requirements of employed adults who wish to upgrade or update their skills and technical capabilities. In this way the school administration, with the help of the committee and special consultants, can effectively initiate the needed program, quickly develop it to a high level of excellence, and maintain its timeliness.

It is strongly recommended that an advisory committee be provided for forest technology. Members should be appointed for fixed terms and rotated to keep the work of serving on the committee from becoming burdensome to any member.

THE CURRICULUM

Curriculum Outline

	Hours per week			
Courses	*Class*	*Laboratory*	*Outside Study*	*Total*
First Semester				
Elementary Forest Surveying	2	6	4	12
Communication Skills	3	0	6	9
Technical Mathematics	4	0	8	12
Botany	2	3	4	9
Dendrology	1	6	2	9
Forestry Orientation Seminar	1	0	2	3
Total	13	15	26	54
Second Semester				
Technical Reporting	3	0	6	9
Elementary Forest Measurements	1	6	2	9
Applied Silviculture	2	6	4	12
Forest Soils	2	3	4	9
Technical Drawing	0	6	0	6
Elementary Business Management	2	3	4	9
Total	10	24	20	54
Summer Work Experience				
On-the-Job Work Experience in the Forestry Field: Summer Program—10 to 16 weeks duration at 40 hours per week				
Third Semester				
Personnel Management	3	0	6	9
Forest Business Methods	2	3	4	9
Timber Harvesting	2	6	4	12
Advanced Forest Surveying	1	6	2	9
Outdoor Recreation	1	6	2	9
Wildlife Ecology	1	4	2	7
Total	10	25	20	55
Fourth Semester				
Elements of Social Science	3	0	6	9
Forest Products Utilization	2	6	4	12
Forest Protection	2	3	4	9
Advanced Forest Measurements	2	8	4	14
Forest Photo-Interpretation	1	6	2	9
Total	10	23	20	53

Final Extended Field Trip

Regional Forest Practices and Utilization: Three weeks of concentrated field observation at the close of the second year, at 40 hours per week

Brief Description of Courses

FIRST SEMESTER

Elementary Forest Surveying

An elementary course in the theory and basic principles of plane surveying emphasizing practical laboratory and field applications in forest surveying.

Communication Skills

A program designed to develop greater competence in reading, writing, and listening.

Technical Mathematics

A course in basic algebraic concepts, radicals, and exponents, with an introduction to graphic and trigonometric functions of angles, particularly as they relate to the applications of right triangles, indentities, and equations in forest surveying.

Botany

An elementary classroom and laboratory study of the forms and living processes of seed plants. It includes a study of the structure and function of roots, stems, leaves, flowers, and seeds. Metabolic processes and responses to stimuli, and a study of plant heredity is included.

Dendrology

An elementary study of trees; their habitats and principal botanical features, forms, functions, and ecological relationships. The major commercially important forest trees of the region are examined in class and through extensive field and laboratory studies. Scientific classification of plants and identification of local flora is emphasized. The content of this course is closely coordinated with *Botany*.

Forestry Orientation Seminar

A course designed to orient the beginning student in a post-high school education program. The student is given occupational and professional orientation by means of panel reports and resource personnel visitations. Consideration is given to the broad historical development of forestry in Europe and the United States, to forest terminology, and to forest policy at various levels. Current events in forest management activities are discussed.

Forest organizations at the private and various governmental levels are examined. A survey of the various kinds of occupations is made, and the demands and opportunities are stressed. Outside study is required. Forestry programs, education, research, and future trends are analyzed. Representative guest lecturers from industry and government are invited to participate.

SECOND SEMESTER

Technical Reporting

A study of effective ways of presenting information. The student learns the utility of illustrations and outlines for various types of oral and written, formal and informal reports. Conciseness, accuracy, and form are emphasized.

Elementary Forest Measurements

A classroom and field study of the basic principles and skills required for timber measurements. Direct and indirect systems of measurement and volume computation, forest type mapping, and graphic reporting are studied and practiced.

Applied Silviculture

An introduction to the artificial reforestation, natural forestation, and silvicultural practices in the United States. Improvements of forest stands through the basic silvicultural practices of weeding, thinning, pruning, and various cutting techniques and the marking of stands prior to logging operations are studied. Laboratory and field exercises are emphasized.

Forest Soils

An elementary study of the basic principles of soils, soil management, and fertility. The geographical and geological formation and classification of soils are examined; and soil organisms, chemicals, conservation, and management are studied. The physical and chemical properties of soil are explored in laboratory exercises.

Technical Drawing

A beginning course for students who have had little or no previous experience in drafting. The principal objectives are to introduce a basic understanding of orthographic projection and freehand sketching, the ability to understand detail and assemble working drawings, and to produce clear, legible, and neat drafting work using current drafting tools and techniques. Topographic drawing and freehand lettering are stressed as requirements for map drafting and forest management activities.

Elementary Business Management

A course which introduces the student to the fundamental principles and techniques of organization, management, and operation of a successful small business enterprise. It includes a study of the principles of inventory, accounting, selling, and other phases of management. Discussions of forest enterprises are presented by guest speakers.

SUMMER WORK EXPERIENCE

On-the-Job Work Experience in the Forestry Field

The student is given an introduction to the various fields of forest technology through employment with a forestry concern or organization in the summer months between his freshman and sophomore years. This occupational experience is very important since it provides the student with the opportunity to practice and observe the application of some of the forestry principles he has learned, to comprehend the need for much more learning, and to be more perceptive in the courses which follow in the third and fourth semesters. The forestry technology faculty keeps close contact with the student and his employer. Regular reports by the student add depth to the experience.

THIRD SEMESTER

Personnel Management

An introductory course in the basic principles of organization for effective personnel management. Selecting and training employees, planning and assigning work, human relations involving motivation, maintaining morale, and special problems of forest technicians are studied. This course is coordinated with courses involving field operations to provide exercises in which students direct the efforts of their fellow students.

Forest Business Methods

An introduction to small business operation, including a study of simple bookkeeping, compound interest, discounts, taxation, capital gains, simple contracts, timber valuation, and recording of timber cutting. State forest laws as they relate to the service and operations required in the conduct of a small forest business enterprise are examined.

Timber Harvesting

A course in timber harvesting, including a study of regional forest harvesting practices, crew organization, planning the harvesting, skidding, loading, transportation methods, operational safety, and cost analysis. Practical experience is emphasized in the laboratory and field exercises.

Advanced Forest Surveying

A continuation of the study of forest surveying providing a greater depth in the study of precision surveying techniques, and the use of precision instruments for plane surveying. Field practice is provided in precision taping, differential and profile leveling, measuring cross sections, and making plane table, transit, stadia, and transit-tape surveys.

Outdoor Recreation

A field oriented study of the use of forest resources for recreation. The course is business oriented and includes a study of the demand for outdoor recreation, kinds of recreational enterprises, use of camp grounds and sport areas, and the selecting, developing, managing, and merchandising of recreational enterprises.

Wildlife Ecology

An introductory study of the principles of wildlife ecology and the conservation of wildlife resources, with emphasis on terrestrial communities. The field and laboratory experiences study wildlife management techniques and how the wildlife population may conflict with forest use.

FOURTH SEMESTER

Elements of Social Science

An introductory study of the social science, beginning with man as an individual, his cultures, social organization, and stratification. It continues with a study of social control principles, and problems of individuals and of society. The objective of the course is to provide the student with a general understanding of people and how they function as individuals, in social groups, and in society generally.

Forest Products Utilization

A course which introduces the student to milling and subsequent utilization of forest products. The process of converting logs to lumber or other marketable products and by-products is studied. Air and kiln drying, lumber stacking, and yard layout are considered. Utilization of milling waste and the marketing of various forest products are studied. The laboratory and field work in this course includes field trips and practical application of the principles studied.

FIGURE 11.—Log dissection is required to teach economical utilization of forest products and accurate timber evaluation. Ownership or leasing of sawmill equipment may be justified if the school operates a sizeable forest area. Cooperative arrangements with a local sawmill for carefully programmed field trips on which previously scaled and estimated log specimens are sawed can provide a minimum laboratory experience in this important area of study.

Forest Protection

An elementary course in the protection of forests from disease, insects, and fire. Special emphasis is placed on the identification of disease-causing organisms and harmful forest insects, with less emphasis on methods employed in their control. The basic principles of forest fire prevention, pre-suppression, detection, behavior, and the various methods, equipment, and crew organization used in fire fighting are studied. The relative emphasis on diseases, insects, and fire factors is optional. Some institutions in some regions may choose to place over half of the course emphasis on protection of forests from fire and to include special studies of man-originated forest fires.

Advanced Forest Measurements

A continuation of the study of forest measurements, including an examination of the current and newest techniques of forest and timber inventory. The principle of stratification in the design of cruises, and the consideration of volume tables and their use are studied. The course is laboratory and field oriented. Formal cruise reports are required in which each student reports his work and describes the types and methods of presentation of technical forest measurement data and reasons for their use. The field work also includes practical experience in preparing a cruise map, and the application of basic statistical knowledge to timber measurements.

Forest Photo-Interpretation

An introduction to the principles and practices of interpreting aerial forest photographs, with emphasis on forest typing, mapping, road reconnaissance, and inventory techniques. The use of aerial photographs to obtain such photogrammetric data as location, direction, area, and timber volume based on photomensurational techniques is studied.

FINAL EXTENDED FIELD TRIP

Regional Forest Practices and Utilization

A 3-week field trip to provide concentrated and varied field observation. It is conducted at the end of the fourth semester to give the student first-hand observation of the current forestry practices in his region. This field observation supplements the on-the-job training experience of the previous sumer and permits him to observe forestry practice, forest harvesting methods, and products utilization in detail which he has studied but may not have seen in operation.

Curriculum Content and Relationships

Successful forest technology programs can be conducted as semester, quarter, or trimester systems. The 2-semester a year system illustrated in this guide can be changed into 3 quarters or terms if advisable to meet community or institutional needs. Course content could be distributed over 3 quarters. For example, Elementary Forest Surveying and Advanced Forest Surveying could become Forest Surveying I, II, and III. The content of other courses could be redistributed and renamed to fit the quarter or trimester systems in whatever manner or division deemed appropriate to provide adequate instruction in the respective subjects.

Functional competence in a broad field such as forest technology has at least three components around which the curriculum must be structured: (1) the training should prepare the graduate to take an entry job in which he will be productive, (2) the broad technical training together with a reasonable amount of experience should enable the graduate to advance to positions of increasing responsibility, and (3) the foundation provided by the training should be broad enough so that the graduate can do further study within his field of technology. This curriculum has been designed to meet these three requirements.

A 2-year technology program has certain unique requirements that influence the content and organization of the curriculum. Some of these requirements are imposed by the occupational functions that graduates must be prepared to perform, some result from the need for special courses that will maximize the effectiveness of teachers who have special competencies, and others arise because of the need to teach both technical principles and related practical application in the limited time available. *The forest technology curriculum reflects three basic requirements: functional utility, units of instruction in specialized technical subjects, and provision for the teaching of principles by application.*

The sequence of the courses in a 2-year technical curriculum is as important as the content of the courses if the limited time available is to be used to full effectiveness. In general, the subject matter in the curriculum is carefully coordinated in groups of concurrent courses, which are arranged so as to blend smoothly from one group of courses into the next, thus carrying the student to a deeper understanding of basic principles while broadening his scope of understanding in the many diverse areas of forestry. This is in sharp contrast to the arrangement of the usual professional curriculum in which basic and somewhat unrelated courses make up the first part of the study program, and specialization is deferred to subsequent terms.

The relationship between laboratory time and class lecture or theoretical study time is of extreme importance in a technical education curriculum. All of the theory, skills, techniques, applied principles, materials, knowledge, processes, and understandings needed by the technician could be taught in the field or laboratory without separate and organized theoretical classes. The converse is *not* true—since laboratory and field experience, skills, know-how, and capability, which are the most characteristic attributes of the technician, *cannot* be learned in classrooms *without* laboratories. However, organized and related ideas, concepts, and factual information can be taught in theory classes, judiciously illustrated by demonstration and other visual aids, employing selected texts and references, and requiring regular and systematic outside study on the part of the student. Group teaching usually makes more efficient use of the instructor's time in a theory class than in a laboratory and tends to emphasize and develop the student's skills in obtaining knowledge from printed sources. Thus, there must be a special relationship between the amount of time spent in the scientific and technical theory classes and that spent in the laboratory and in the field.

This curriculum provides a heavy distribution of time to field and laboratory hours in the *technical specialty*. Introductory field and laboratory skills and knowledge of apparatus, tools, processes, materials, devices, and good practices can and should be learned under actual conditions as early as possible, and can be started without much underlying theory. As soon as the underlying theory can be developed and understood it can be increasingly incorporated into laboratory and field work which then becomes a more significant experience for teaching the subject in depth.

Since many basic skills have been learned in the first year and since enough basic theory underlying the new material has been required, the laboratory and field time required to illustrate principles and to teach *new* material in second-year courses need not be as long as in the first 2 semesters. Since more technical specialty courses are studied in the third and fourth semesters than in the first and second, the total laboratory and field time may be greater than in the first year. Experience has shown that the relative number of semester hours of science or technical specialty laboratory and field work compared to class theory hours should not be reduced materially in teaching forest technicians. Such a reduction usually causes loss of interest and failure or dropping out of the typical student or it produces a graduate who is deficient in the absolutely essential laboratory and field capabilities and is therefore untrained for his occupational objectives and unemployable at the technician level.

The laboratory and field exercises suggested in this curriculum outline and in the course descriptions are not necessarily intended to be a single session, but rather total hours of laboratory per week to be scheduled in reasonable and effective increments. For example, a 4-hour laboratory total per week for a course might be scheduled as two 2-hour sessions or one 4-hour session, depending on the subject.

In technical curriculums it is mandatory that at least a minimum of specialized technical course work be introduced in the first semester. This is subject, of course, to climatic conditions, since a majority of the laboratory work is done in the field. Deferring this introduction even for one term imposes serious limitations on the effectiveness of the total curriculum. Several important advantages occur from an early introduction of the technical specialty:

1. If the student starts his training immediately in his specialty, his motivation will be intense. If the first semester consists entirely of general subjects—mathematics, English, social studies—students often lose interest.
2. By introducing the technical specialty in the first semester, it is possible to achieve greater depth of understanding in specialized subjects in the later stages of the 2-year program.
3. The student sees immediate application for the principles he studies in mathematics and elementary forest surveying courses.

Discipline and intellectual honesty must be a part of the training of the technician. Ethical conduct and the need for and the rewards of integrity must be taught by principle and by staff example. The student must report accurately what he observes. Any modification of the observed data should be fully explained in his record of the work. False reporting should be dealt with seriously by every instructor. The original data reported by an employed technician may become evidence in a court of law and its accuracy should be thoroughly stressed.

Throughout the course of study, the student is trained in the scientific method of observation and to record his observations in laboratory reports. A laboratory notebook should be required for all laboratory courses.

Safety and careful workmanship must be a central theme throughout the course of study. The technician's work often involves potential dangers that careful procedures combined with an understanding of the equipment and the use of normal safety practices can avoid. In addition to protecting human life, the practice of careful workmanship will also protect instruments and expensive equipment the forest technician uses. Safety must be a constant preoccupation, and its practice must be emphasized continually from the beginning.

During the first semester, *Elementary Forest Surveying* provides the student with a basic understanding of one of the fundamental concepts behind forest management as it relates to the ownership and use of forest lands.

Technical Mathematics prepares a student to understand concepts which allow him to utilize the basic trigonometric tools in *Elementary and Advanced Surveying* course work.

Dendrology and *Botany* complement each other insofar as the understanding of tree physiology, growth, identification, and ecology is concerned, and provide the basic plant science principles for the rest of the curriculum. They form the basis for the study and the understanding of growth characteristics in *Elementary Forest Measurements* and *Applied Silviculture,* hence the course sequence which gives the student a sound background in the cell structure and ecology of the various species. *Forest Soils* provides the student a basic understanding of the movement of water, of soil types and their effects upon forest growth; this, too, is given early in the student's curriculum so that the knowledge gained will be usable in later work.

Elementary Business Management precedes *Forest Business Methods* since a basic understanding of business terminology is mandatory prior to the consideration of forest business procedures in depth.

On-the-Job Work Experience between the first and second years with a forestry concern enables the student to apply the skills and knowledges learned in the first 2 semesters and to obtain new ones. It is very important at this point for the student to obtain knowledge and be exposed to ideas from persons in the forestry profession other than his instructors. This period should extend from a minimum of 10 weeks to a maximum of 16 weeks, depending upon the school calendar.

Timber Harvesting presents the actual harvesting operations wherein a student begins to understand the economics of forest production and planning including equipment purchasing, maintenance, and use.

Courses such as *Outdoor Recreation, Elements of Social Science,* and *Wildlife Ecology* assist the student in understanding the social, psychological, economic, and ecological factors influencing forest management policies associated with land-use programs. The student is exposed to the various concepts of outdoor recreation of all forms, and its compatibility with timber production in terms of past, present, and future uses of forest land.

Personnel Management is presented in the third semester in order to prepare the student for leadership potential in his technical specialty during his final semesters.

The last semester provides further depth of comprehension and practice in the application of principles, techniques, skills, and concepts previously learned. Advanced work in *Forest Measurements* and *Forest Photo-Interpretation* are given here so that the total relationships of inventory techniques can be appreciated and consolidated in both programs. It is necessary for a student to relate the photo-visional relationships of his work in interpretation to the operations of cruising timber. *Forest Products Utilization* is an introduction to the basic utilization of forest products, and is the portion of the program wherein utilization and marketing of sawmill and industrial waste materials are presented to provide the student with an understanding of *utilization as it affects the practice of forestry.*

Forest Protection is given at this time in order for the student to understand the insect, disease, and fire problems of forest management. The basic identification and control of insect and disease epidemics are illustrated in this course.

Close correlation of concurrent courses has not been stressed as strongly in the third- and fourth-semester courses as in the earlier courses due to the diverse areas of study in the second year. Necessarily, there are areas of overlap in course content throughout the second year, but by scheduling regular discussions between members of the staff teaching concurrent second-year courses, the most effective material may be prepared for each course, thus eliminating duplication of material and the loss of time.

Communication Skills emphasizes the mechanics of reading, writing, listening, speaking, and reporting early in the curriculum (first semester). These skills are reinforced by *Technical Reporting* in the second semester. Instructors in the technical courses must set increasingly high standards of clarity, conciseness, and neatness for student reports. Freedom to report on technical subjects of their own choice may add reality and extra motivation for technology students.

In the final phases of the 2-year program, the standards of reporting should approach those required by forestry organizations. At the same time, instructors should encourage individual style and initiative by allowing as much freedom as possible in reporting, consistent with established school standards. Not all reports should be of a type which require a large number of hours for preparation. The judicious use of informal as well as formal reporting allows training in both forms, introduces the realism encountered in employment, and limits the time required for writing formal reports to a reasonable portion of the students' time.

A tour of the major regional forest industries is desirable at the end of the formal 2-year program. This tour should be a minimum of 2 weeks' (preferably 3) duration. It assists the student in consolidating the concepts, ideas, and practices learned in the previous 2 years plus the summer training period into a comprehensive understanding of forest management practices in the region.

It is essential that forest technician programs be clearly distinguished from the first 2 years of baccalaureate degree programs. Separate courses should be maintained for students in technician programs and for those in 4-year baccalaureate forestry programs because the objectives of each are different and thus the preparation must be different. To place first- or second-year baccalaureate students and student technicians in the same classes is unsuitable to the needs of both groups of students.

Suggested Continuing Study

A 2-year curriculum must concentrate on the primary needs of science, mathematics, and the related knowledge and skills of the technology necessary for the preparation of the student for employment upon graduation.

Obviously, such a course of study cannot cover in-depth all of the subjects which are pertinent to the technology. Some important related subjects may only be touched upon in that time.

Some form of continued study for graduates of technology programs is therefore mandatory. By reading the pertinent current literature related to the technology, the student may keep abreast of the technical developments in a special field, but this tends only to build on the organized technological base provided by the curriculum studied.

Formal continuation or supplementary courses provide the most efficient and practical means for the graduate technician to add important related areas of knowledge and skill to his initial education. They have the advantages of systematic organization of subject matter, disciplined and competent teaching, class discussion, and they may be scheduled for evening or Saturday hours outside the graduate's working day. Naturally, an intelligent man has the ability to learn through experience and association with skilled and professional men in the field. (He is also subject to picking up poor work habits and methods from the same sources). Most of all, however, he must continue to study to avoid technological obsolescence.

This program is not intended to make the individual proficient in all of the duties he might be asked to perform. Proficiency in work of a highly specialized nature will come with practice and experience. It is impossible to forecast the exact requirements of any individual, and it is almost impossible to predict accurately the course or rate of change of various technologies. Employers generally recognize that recent professional forestry graduates may require a year or more to obtain the specific training needed to orient them to their responsibilities and roles in any organization. Similarly, employers of newly graduated forest technicians must generally provide a 3- to 6-month period to orient the technicians to the special situations, processes, and problems encountered on the job. Furthermore, the productive graduate technician will continue to study throughout his career in order to develop to his fullest capabilities.

Some suggested continuation or extension courses for graduates of this forest technology curriculum follow:

Elementary Statistics
Applied Forest Photo-Interpretation
Advanced Mensuration
Psychology and Human Relations
Basic Physics
Advanced Logging Techniques
Road Location and Boundary Line Surveying
Road Engineering
Bridge Construction and Forest Improvements
Industrial Management and Supervision
Advanced Communications
Advanced Fire Prevention
Data Processing Applied to Forest Enterprises

COURSE OUTLINES

The courses which follow are intended to suggest the content which might be taught in the curriculum. The material suggested provides a practical and attainable coverage of the field and has been reviewed by experienced instructors in successful forest technician educating programs and by representative employers of skilled forest technicians.

It is expected that these materials will be modified in some measure to fill the needs as defined by local advisory committees to emphasize the important characteristics of forestry in the region. However, the implied level, quality, and completeness of the program should not be compromised.

The course outlines included in this guide are concise and comprehensive. They are intended as guides rather than as specific plans of instruction to be covered in an inflexible order or sequence. They represent a judgment on the relative importance of each instructional unit, especially where time estimates are shown for the divisions within each course. It is expected that the principles outlined in these courses will be supplemented with practical applications whenever possible. Field trips add greatly to the effectiveness of the instruction if they are carefully planned in advance so that the processes observed are understood and related to the subject material being studied at the time of the trip.

Outside study is a significant portion of the student's total program. In this curriculum, *2 hours of outside study time have been suggested for each hour of scheduled class time.* A typical weekly work schedule for students in the first semester of this curriculum would be: class attendance, 13 hours; laboratory, 15 hours; outside study, 26 hours—a total of 54 hours. This is a full schedule but not excessive for this type of program.

It should be noted that no examinations have been scheduled in the outlines. It is clearly intended that time be available for examinations. Therefore a 17-week semester is assumed, and the outlines are designed to cover a full 16 weeks. The primary objectives of examinations are to evaluate the student's knowledge and cause him to make a periodic comprehensive review of the material presented in the course. The results of examinations may also point out weaknesses in teaching techniques.

At the end of each course is a list of text and reference materials. Each should be analyzed for its content and pertinency. New and more suitable ones should be substituted if they become available. The information needed to cover a particular course in technician educating curriculums, particularly the technical specialty courses, is almost never available in one textbook; hence, the multiple references. Usually, they should be considerably augmented by current materials from manufacturers, trade journals, technical societies and associations, and suppliers of apparatus and services in the field of applied science being studied.

Suggested visual aids are listed for many courses. Each should be used when pertinent and when its use will teach more efficiently than any other method. *Excessive showing of films at the expense of well-prepared lectures and demonstrations is to be avoided.* The suggested outside study periods may well be utilized instead of class lecture time for the showing of some films. All visual aids should be examined by the instructor before they are shown.

It is expected that the experienced instructor will make maximum use of real examples such as particular forest areas and liberal use of charts, slides, models, samples, and specimens which illustrate special technical aspects of the subject. These usually are accumulated from previous laboratory, field, or lecture preparations by the instructor, and should be updated regularly when new developments require it. They are too specific to be listed in this guide.

Technical Courses

ELEMENTARY FOREST SURVEYING

Hours Required

Class, 2; Laboratory and/or Field, 6.

Course Description

An elementary course in surveying including the fundamentals of plane surveying and the use and care of equipment. Understanding of the theory of measurements, solution of triangles, angles, bearings, and azimuths is emphasized; students become familiar with mapping and proficient with the use of the staff compass, the Abney level, and engineer's and surveyor's tapes.

If at all possible, it is recommended that courses in technical mathematics and drawing be taken prior to or concurrently with Elementary Forest Surveying.

It is not necessary to follow the sequence of the subject matter in the detailed outline. In cases where the geographical location of the school is such that extreme or inclement weather conditions occur early in the semester, indoor work such as computations and plotting may need to be given prior to field work. Since surveying is an outdor activity, every effort should be made to provide the maximum in field exercises.

Terrain selected for field problems should be rugged enough to introduce normal complexities but not to the point of requiring excessive time in execution. Areas used for surveys should be such that stakes for unfinished exercises can be left in place until the survey is completed, after which each survey party should remove the stakes and other markings. Laboratory-field survey periods will generally be at least 3 hours twice a week, with a 2-hour period for class lectures and problem solving; however, this will also vary. Field work should approximate industrial practice, with proper stress on the degrees of precision required in good surveying practice.

Field notes should be reduced to a convenient form for plotting or calculation of distances, areas, and volumes. Field notebooks should be kept according to good professional practice and errors of closure recorded. If a survey party on a field problem exceeds the permissible error, it should repeat the problem outside the regular class hours. Students should become proficient in the duties of each member of a survey party by rotating from position to position. They should be required to read and study the daily assignments as homework. It is also expected that the students will have some computations to finish outside of class time after having started them in the classroom.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Introduction and Field Notes	2	2
II. Linear Measurements	5	8
III. Direction—Angles and Bearings	6	12
IV. Boundary Surveys	3	18
V. Traversing	5	30
VI. Mapping	3	12
VII. Determination of Area	3	8
VIII. Public Land Surveys	5	6
Total	32	96

I. Introduction and Field Notes
  A. Units of Instruction
    1. Definition of surveying
    2. Kinds and classes of surveys
    3. Precision and accuracy
    4. Sources of surveying information
    5. Field notes

  B. Laboratory and/or Field Projects
    1. Errors and mistakes

    - a. Demonstrate difference between errors and mistakes
    - b. Demonstrate difference between precision and errors
    - c. Illustrate different classes of errors
    - d. Demonstrate methods that result in reduction of errors
  - 2. Show relation between angles and distances

II. Linear Measurements

- A. Units of Instruction
  - 1. Units of length
  - 2. Instruments
    - a. Steel tapes, surveyor's and engineer's
    - b. Steel pins
    - c. Chains
    - d. Range poles
    - e. Plumb bobs
    - f. Care of equipment; splicing tapes
  - 3. Pacing
  - 4. Measuring with steel tape
    - a. Level ground
    - b. Sloping or uneven ground
  - 5. Use of surveyor's topographic tape
    - a. Tape held level
    - b Tape on the ground
    - c. Abney level and topographic tape
  - 6. Stationing
  - 7. Errors in taping
    - a. Incorrect length; corrections
    - b. Slope and alignment
    - c. Tension
    - d. Plumbing points and setting pins
  - 8. Mistakes in taping
    - a. Omitted tape length
    - b. Misreading tapes
    - c. Calling and recording numbers
    - d. Mistakes on add and subtract tapes
  - 9. Special problems in the use of tapes
    - a. Measuring around obstacles
    - b. Measuring inaccessible lines
  - 10. Student problems on linear measurements
- B. Laboratory and/or Field Projects
  - 1. Practice pacing and converting distances to feet around a level traverse of a known area. Compute precision.
  - 2. Using an engineer's tape, tape around a level traverse of a known area. Compute precision.
  - 3. Practice pacing a known traverse of a wooded area of rough topography. Compute precision.
  - 4. Using a topographic tape and related equipment, tape a traverse in a wooded area of rough topography. Accuracy with the above measurements must be within the allowable limits. If not, field problems are to be repeated.

III. Direction—Angles and Bearings

- A. Units of Instruction
  - 1. General remarks
  - 2. Bearings
    - a. Meridians—magnetic, true and assumed
    - b. Magnetic declination
    - c. Magnetic bearings—conversions
    - d. True bearings—conversions
  - 3. Geodetic azimuths
    - a. Azimuth and back azimuth
    - b. Bearings to azimuths and azimuth to bearings
  - 4. Closed and open traverses
    - a. Interior angles
    - b. Exterior and deflection angles
  - 5. The compass and its use
    - a. Reading a bearing
    - b. Calculating bearings from angles and angles from bearings
    - c. Sources of errors
      - (1) Parallax
      - (2) Needle bent or sluggish
      - (3) Local attraction
      - (4) Variations of declination
    - d. Mistakes
      - (1) Misreading quadrant letters
      - (2) Transposing the quadrant letters
      - (3) Misreading the circle
    - e. Accuracy
  - 6. Student problems on the measurement of direction
- B. Laboratory and/or Field Projects
  - 1. Set a series of points and determine the bearings of known objects; compute the angles between points.
  - 2. Set up a closed traverse and determine the bearings of a series of lines. Compute the interior and deflection angles of the traverse.

3. Compute the corrected bearings of lines originating at a point containing magnetic attraction.
4. Drive four or five stakes at random to form an irregular polygon no side of which is less than 150 feet. Beginning at any stake, survey this polygon, measuring the forward and back bearings of each line and its length.

IV. Boundary Surveys
- A. Units of Instruction
  1. General
  2. Basis of land titles
  3. Property description by metes and bounds
  4. Property description by block and lot
  5. Property description by coordinates
  6. Registration of title
  7. Registry of Deed procedure
  8. Registry of Probate procedures
  9. Establishing past declination from known monuments
  10. Establishing bearings by trial line
  11. Determining bearings by offsets
- B. Laboratory and/or Field Projects
  1. From present declination and a line between two known points, set up a compass and determine the past declination. From this compute present bearings of a past survey.
  2. Set up a line between two points, one of which cannot be seen from the other. Determine the actual bearing by trial line. On the same line, determine the bearing by right angle offsets with a staff compass and tape.
  3. Make a thorough title search from the Registry of Deeds and the Registry of Probate of a parcel of land near the campus. From the data gathered, search the area for landmarks or monuments called for in the deed.
  4. Retrace the original surveyor's tracks to determine errors and problems encountered.

V. Traversing
- A. Units of Instruction
  1. Definition and uses
     - a. Open traverse
     - b. Closed traverse
  2. Methods of running a traverse
     - a. Traverse by compass bearings
     - b. Traverse by direct and deflection angles
     - c. Traverse by azimuths
  3. Measurement of length
  4. Selection of traverse hubs
  5. Angle closure
  6. Organization of field party—traverse notes
  7. Use of traverse computation forms and tables
  8. Traverse by latitudes and departures
  9. Transit rule
  10. Compass rule
  11. Statewide coordinate systems
  12. Computations of missing bearings and distances from latitudes and departures or coordinates
  13. Sources of error
- B. Laboratory and/or Field Projects
  1. Assign a boundary survey of a wooded area of at least 30 acres of varying topography to a survey party of three men. Assign survey parties to specific tasks so that each student will have an opportunity to participate and become acquainted with all the field procedures.
  2. Conduct a surveying exercise of the area, emphasizing the use of compass, tape, Abney level, and notekeeping. Walk the area with the students to acquaint them with the landmarks. Locate all topographic features on line and witness all corners. The data obtained from this survey should be utilized in later laboratory sessions on mapping and area computations.

VI. Mapping
- A. Units of Instruction
  1. General information
  2. Drafting and lettering
  3. Plotting
     - a. Coordinate method
     - b. Tangent method
     - c. Chord method
     - d. Protractor method
     - e. Latitudes and departures
  4. Plotting detail
  5. Plotting contours
  6. Topographic symbols

7. Title and balance
8. Sources of error
9. Student homework problems

B. Laboratory and/or Field Projects
  1. Map an area with data obtained from the survey completed in the previous assignment by latitudes and departures.
  2. Map the same area by protractor and scale and compare the error of closure obtained from both methods.
  3. Using contour data obtained with the previous exercise, plot contours on the plat.

VII. Determination of Area
  A. Units of Instruction
    1. General information
    2. Field measurements
      a. Triangulation
      b. Offsets
      c. Double meridian distances
      d. Coordinates
    3. Map measurements
      a. Division of area into triangles
      b. Coordinate squares
      c. Polar planimeter
      d. U.S.D.A. Forest Service dot grid
  B. Laboratory and/or Field Projects
    1. Calculate the area of survey completed in V by double meridian distances, triangulation, polar planimeter, and U.S.D.A. Forest Service dot grid.
    2. Conduct other exercises using area determination methods.

VIII. Public Land Surveys
  A. Units of Instruction
    1. General information
      a. Boundaries
      b. Division
    2. Initial point of survey
    3. Principal meridian
    4. Base line determination
      a. Solar method
      b. Tangent method
    5. Parallels
    6. Guide meridians
    7. Township lines and corners
    8. Subdivision to sections
    9. Subdivision of sections
    10. Fractional sections
    11. Meander lots and corners
    12. Lost and obliterated corners
    13. Description by township, section, and smaller subdivision
    14. Sources of error
    15. Selected student problems for homework assignment
  B. Laboratory and/or Field Projects
    Make a field trip, if feasible, to an area laid out by the public land survey system and retrace survey showing lines of convergence and section corners. Have the representative of the agency discuss the utility of the public land survey system and explain some of the problems associated with the establishment and use of public land surveys.

Texts and References

BOUCHER *and* MOFFIT. *Surveying.*
BREED. *Surveying.*
BRINKER *and* TAYLOR. *Elementary Surveying.*
BROWN. *Boundary Control and Legal Principles.*
BROWN *and* ELDRIDGE. *Evidence and Procedure for Boundary Location.*
DAVIS. *Elementary Plane Surveying.*
FORBES. *Forestry Handbook.*
KISSAM. *Surveying.*
LOW. *Plane Table Mapping.*
MEYER. *Route Surveying.*
PAFFORD. *Handbook of Survey Notekeeping.*
U.S. DEPARTMENT OF THE ARMY. *Elements of Surveying.* Army Technical Manual TM 5-232.

FORESTRY ORIENTATION SEMINAR

Hours Required

Class, 1; Laboratory, 0.

Course Description

A course in which the student is introduced to the educational institution, the new type of learning situation he is entering, the objectives of the Forest Technician Program, and the career opportunities as a forest technician.

The multiple-use concept and the historical development of forestry are presented. Major and allied forestry fields are discussed to give the student an understanding of forestry. Current forestry programs of Federal, State, and private organizations are described and studied. The remainder of the course is devoted to giving the student occupational and technical orientation by means of lectures, visual aids, library and outside study assignments, and the use of representative guest speakers.

Major Divisions

	Class Hours
I. The Student and the School	2
II. Multiple-Use Concept of Forestry	1
III. Development of Forestry in the United States	2
IV. Forestry and Its Allied Fields	3
V. Current Programs in Forestry	3
VI. Co-operative Training Programs	1
VII. Career Employment Opportunities	4
Total	16

I. The Student and the School
Units of Instruction
1. The forest technician curriculum
   a. Objectives
   b. Curriculum design
   c. Other types of non-professional training programs
2. Applied vs. theoretical approaches in instruction and training
3. Organization of field work
   a. Percentages of time in the field
   b. Care of equipment and machinery
   c. Crew organization—team work
   d. Class field trips
4. Four-year schools' transfer policies
   a. Accreditation of forestry schools
   b. Admission policies of Eastern and Western schools
5. Special student equipment required
6. Sources of forestry reference material

II. Multiple-Use Concept of Forestry
Units of Instruction
1. Wood
2. Water
3. Wildlife
4. Forage
5. Recreation

III. Development of Forestry in the United States
Units of Instruction
1. Forestry in colonial times
2. Federal
3. State
4. Farm
5. Private

IV. Forestry and Its Allied Fields
Units of Instruction
1. Protection
2. Management
3. Harvesting
4. Wood procurement
5. Lumber manufacturing and sales
6. Wood: its nature and uses
7. Secondary forest products

V. Current Programs in Forestry
Units of Instruction
1. Federal
   a. U.S.D.A. Forest Service
   b. Bureau of Land management
   c. Bureau of Indian Affairs
   d. National Park Service
   e. U.S. Fish and Wildlife Service
   f. Tennessee Valley Authority
   g. Federal Cooperation Programs
   h. Others
2. State

3. Colleges of forestry
4. County and community forests
5. Industry and other private forest programs

VI. Co-operative Training Programs
Units of Instruction
1. Necessity
2. Requirements
    a. School
    b. Employer
    c. Student
3. Summer employment opportunities
4. Employers sympathetic to training forest technicians

VII. Career Employment Opportunities
Units of Instruction
1. Demand for trained forest technicians
2. Private industrial employment
    a. Salary comparisons with other agencies
    b. Opportunities for advancement
    c. Organizational structures
        (1) Large
        (2) Small
3. Agencies other than industrial
    a. Federal Government
        (1) U.S.D.A. Forest Service
        (2) Bureau of Indian Affairs
        (3) Bureau of Land Management
        (4) Bureau of Outdoor Recreation
        (5) National Park Service
    b. State
    c. Local
        (1) County
        (2) City
        (3) Associations
        (4) Estates
        (5) Co-operatives

Texts and References

CLEPPER. *Careers in Conservation.*

CLEPPER and MEYER. *American Forestry—Six Decades of Growth.*

CLEPPER and MEYER. *The World of the Forest.*

COLLINGWOOD and BRUSH. *Knowing Your Trees.*

MEYER. *Forestry as a Profession.*

PERRY and PERRY. *Foresters and What They Do.*

RANDALL. *So You Want To Be a Forester?*

U.S.D.A. *Trees: The Yearbook of Agriculture.*

U.S.D.A. FOREST SERVICE. *Managing the Family Forest.*

U.S.D.A. FOREST SERVICE. *Products of American Forests.*

U.S.D.A. FOREST SERVICE. *Careers in Forestry.*

U.S.D.A. FOREST SERVICE. *Forestry Schools in the United States.*

U.S.D.A. FOREST SERVICE. *In Your Service—The Work of Uncle Sam's Forest Rangers.*

Visual Aids

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

Timber Management on the White Mountain National Forest. 146 slides with tape.

ELEMENTARY FOREST MEASUREMENTS

Hours Required

Class, 1; Laboratory and/or Field, 6.

Course Description

This course is designed to teach the student technician the basic skills and principles of timber measurement. Its objective is to prepare the technician to measure the volume of a growing stand of timber, its quality and its rate of growth, and to measure the volume of various products removed from the land.

Mathematics and the geometric principles related to tree growth and measurement are stressed as a continuation of material presented in Technical Mathematics. The course stresses the techniques and principles of log grading, long and short log scaling, and the factors relating to growth in the forest stand. The effect of log defects on volume and grade of lumber are demonstrated by "opening up" selected logs in the sawmill and giving students the opportunity to analyze the results.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Introduction to Forest Measurement	1	0
II. Principles of Measurement	1	6
III. Volume Measurement	4	24
IV. Log Rules and Log Scaling	4	30
V. Measurement of Diameter and Height of Standing Trees	2	6
VI. Log and Tree Grading	2	18
VII. Factors Affecting the Growth of Trees	2	12
Total	16	96

I. Introduction to Forest Measurements
Units of Instruction

1. Standard units of measurement as used in forestry
    - a. Measurement of products and logs
    - b. Measurement in the tree
    - c. Measurement of growth
2. Scope of forest measurements
    - a. Reason for inventories
    - b. Reason for volume calculations

II. Principles of Measurement

A. Units of Instruction

1. Introduction to measurements
2. Accuracy of measurements
    - a. Errors
    - b. Rounding-off
    - c. Significant figures
3. Review of basic mathematics
    - a. Ratio
    - b. Percentages
    - c. Proportion
    - d. Area
    - e. Volume (geometric principles)
4. Data gathering and methods of presentation
    - a. Graphs
    - b. Curves

B. Laboratory Projects

1. Mathematical problems using conversion factors
    - a. Length—inches to links, feet to chains, feet to rods, feet to meters
    - b. Area—square inches to square feet, square feet to acres, square feet to square meters, square feet to square chains, square chains to acres
    - c. Volume and capacity—cubic inches to cubic feet, cubic feet to cubic yards, cubic feet to bushels, fluid ounces to cubic inches, pints to cubic inches, gallons to cubic inches
    - d. Weight—pounds per square feet to pounds per square inch, gallons of water to pounds, cubic feet to pounds of water
    - e. Quantity of forest products—fence posts to board feet, poles to board feet

- f. Equivalent forest products—cubic feet to board feet, board feet to cords, cubic feet to cords
- 2. Selected problems in the use of desk calculators
  - a. Four basic operations
  - b. Rounding-off
  - c. Significant digits
- 3. Require the students to present basic data in curve and graph form and to identify the variables

III. Volume Measurement
- A. Units of Instruction
  - 1. Cubic content
    - a. Basal area calculations
    - b. Types of log forms
    - c. Volume by geometric formulas
  - 2. Commercial methods of log measurement
    - a. Scaling
    - b. Weight
  - 3. Log rules used based upon cubic content of logs
  - 4. Pulp measurements
    - a. Utility and current practices in the region
    - b. Measurement by weight
    - c. Units of stacked or cord measurement
    - d. Solid cubic contents
    - e. Deduction for defects in bolts and piling
    - f. Conversions of cubic volume to board measure
  - 5. Form class measurement
    - a. Construction of form class tables
    - b. Use in modifying local volume tables
- B. Laboratory Projects
  - 1. Determine the cubic volume of felled trees using several approximation formulas.
  - 2. Determine the form class of a sample number of trees in a forest stand and compute the volume of timber in a selected area using appropriate standard volume tables as modified by the form class data gathered.
  - 3. Determine the gross and net cord volume of a number of ranks of cordwood piled in the woods, by the roadside, and on slopes.

IV. Log Rules and Log Scaling
- A. Units of Instruction
  - 1. Factors causing variation in sawed output of logs
  - 2. Diagram rules, construction and use
  - 3. Formula rules, construction and use
  - 4. Log rules based on mill tally
    - a. Overrun and underrun
    - b. Waste from saw kerf and slabs
  - 5. Scaling straight, sound logs
    - a. Diameter measurement
    - b. Lengths
    - c. Bark thickness considerations
    - d. Required standards of accuracy
  - 6. Scaling defects as they affect volume
    - a. Crook or sweep
    - b. Exterior defects
    - c. Interior defects
    - d. Merchantable vs. cull logs
  - 7. Scaling records and check scaling
- B. Laboratory Projects
  - 1. Identify various species of logs by bark and wood characteristics under field conditions.
  - 2. Demonstrate the use of various log rules and their applicability in local regions.
  - 3. Scale a number of selected hardwood and softwood logs on the brow, in the woods, and at the mill landing; determine gross and net volume.
  - 4. Saw a selected number of logs after determining net volume and compare log tally with mill tally.
  - 5. Discuss defects as they appear in the log and the lumber.

V. Measurement of Diameter and Height of Standing Trees
- A. Units of Instruction
  - 1. Total height vs. merchantable height
  - 2. Use and advantages of various height measuring devices
    - a. Hypsometer
    - b. Abney level
    - c. Haga altimeter
    - d. Spiegel Relaskop
    - e. Trigonometric methods
  - 3. Major errors in height determination
  - 4. Tree diameter measurements
    - a. Diameter tape
    - b. Biltmore stick

        - c. Calipers
        - d. Dendrometers
    - 5. Major errors associated with the use of the above devices
  - B. Laboratory Projects
    - 1. Measure the heights and diameters of selected tree species by using the above instruments.
    - 2. Set up a problem in which the students will be required to measure tree heights and diameters under adverse conditions such as varying stand densities and slopes.

VI. Log and Tree Grading
  - A. Units of Instruction
    - 1. Introduction to lumber grades and grading rules
    - 2. Basic principles of log grading of local species
      - a. Requirements of grades
      - b. Grading defects
      - c. Softwood log grades
      - d. Hardwood log grades
  - B. Laboratory Projects
    - 1. Examine a selected group of logs at the landing and at the sawmill for log defects; discuss defects as they affect grade.
    - 2. Diagram a selected group of logs for defect characteristics.
    - 3. Set up a control area of locally commercial species and require the students to grade selected trees.
    - 4. Require a report, stressing the economic aspects of tree and log grading. This report should include the student's tree grading results under item 3.

VII. Factors Affecting the Growth of Trees
  - A. Units of Instruction
    - 1. Climatic cycles
    - 2. Normal mortality
    - 3. Characteristics of growth
      - a. Age of trees
        - (1) Increment cores
        - (2) Total and seedling age
      - b. Height growth based on age
      - c. Diameter growth based on age and other factors
    - 4. Factors affecting growth
      - a. Site quality
      - b. "Site index" as an expression of site quality
        - (1) Reading site index curves
        - (2) Evaluation of site quality
        - (3) Species indicators
      - c. Site classification
  - B. Laboratory Projects
    - 1. Determine the site index of one or two local commercial species in selected areas exhibiting site index differences.
    - 2. Determine the average age and the density and quality of selected stands on different sites and compare them; construct site index curves for the areas studied.

Texts and References

AVERY. *Forest Measurements.*
DRESSLER. *Review Text in Preliminary Mathematics.*
HUSCH. *Forest Mensuration and Statistics.*
U.S.D.A. FOREST SERVICE. *Grade Defects in Hardwood Timber and Logs.*
U.S.D.A. FOREST SERVICE. *A Guide to Hardwood Log Grading.*
U.S.D.A. FOREST SERVICE. *A Guide to Log Diagramming for Eastern Softwoods.*
U.S.D.A. FOREST SERVICE. *National Forest Log Scaling Handbook.*

Visual Aids

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

How We Grade Northern Hardwood Trees. A slide-tape-program.

The Forest Service Scaler. A slide-tape program.

APPLIED SILVICULTURE

Hours Required

Class, 2; Laboratory and/or Field, 6.

Course Description

An introductory course in applied silviculture in which the influence of biological laws on forest culture is studied. The subject matter deals with the science of producing and tending the forest. The principles involve the nature of forest trees and stands, their growth, reproduction, environment, composition, nutrition, and various responses. The practices relate to the methods of handling forests as modified by economic factors.

A brief discussion of the significant biological, physical, and economic qualities of the various forest regions of the United States and their effect on silvicultural practices are presented. Emphasis is then placed on regional conditions, on the physiography, ecology and soils, climate and weather, and the silviculture of the major tree groups.

The course considers the various treatments given a forest stand to maintain and increase forest production in light of the fact that the major objective of forestry is economic and that foresters must be able not only to obtain maximum growth and quality from trees, but also to estimate the economic potential at the same time. Technicians must be trained to help produce more useful forests than nature does and in less time. The laboratory and/or field exercises for this course must be made as practical as possible by providing actual field observations and practice. As much practical experience as possible must be given to technical students under field conditions to develop leadership qualities and abilities.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Introduction and History	2	8
II. Regulation of Stand Composition	6	22
III. Regulation of Stand Growth Through Thinning	6	16
IV. Pruning	2	6
V. Regeneration of Forest Stands	6	24
VI. Specialized Tree Production	2	8
VII. Silvicultural Systems	4	12
VIII. Commercial Forest Regions of the United States	4	0
Total	32	96

I. Introduction and History
- A. Units of Instruction
  - 1. Objectives of silviculture
    - a. Control stand density
    - b. Control stand composition
    - c. Protection and salvage
    - d. Control length of rotation
    - e. Influence quality and quantity of stands
    - f. Protection of site
    - g. Restocking
  - 2. History of silviculture and past management considerations
    - a. European
    - b. Early systems and their evolution to present U.S. systems
- B. Laboratory Projects
  - 1. Observe and discuss the different stand types and species composition in stands within easy traveling distance from the school.
  - 2. Choose one mixed-composition stand of sufficient area and thoroughly ground the students in the principles of species occurrence on a particular site and the environmental influences on growth and composition. Discuss market conditions affecting the growing and cutting of local commercial species.
  - 3. Present a technical report on the discussion as it pertains to the produc-

tion of commercially valuable timber in the local area.

II. Regulation of Stand Composition
  A. Units of Instruction
    1. Type of release cuttings
      a. Liberation cut
      b. Cleaning (weeding)
    2. Trees to be removed
    3. Stand age and composition
    4. Volume removed
    5. Herbicides
      a. Types by chemical composition, trade name, and concentration
      b. How the herbicide causes tree mortality
      c. Mixture, rate, and time of application
      d. Recording pertinent data when using herbicides
      e. Utilization
        (1) Frill
        (2) Basal spray
        (3) Tree injector
        (4) Mist blowing
        (5) Aerial spraying
        (6) Soil sterilant
        (7) Chemical debarking
      f. Problems associated with the use of chemicals
        (1) Safety hazards to man and animals
        (2) Corrosion of equipment
        (3) Sprouting
        (4) Epicormic branching of hardwoods
  B. Laboratory Projects
    1. Demonstrate the mixing of chemicals, the tools used, and the technique of manipulating these various tools under field conditions to alter or control species composition in a stand.
    2. Give the students an extended field exercise covering several periods in the techniques of using each tool. Allow each student to use each tool and to become thoroughly familiar with its advantages and disadvantages under various forest type conditions.
    3. Require a report explaining the layout of the work, stand composition, species treated, acreage, and other pertinent factors making up the exercise.

III. Regulation of Stand Growth Through Thinning
  A. Units of Instruction
    1. Thinning in relation to individual tree growth
      a. Tree form
      b. Crown classification
      c. Live crown ratio
    2. Effect of thinning on:
      a. Economic yield of stand
      b. Diameter growth and yield of the stand
      c. Other physiological responses
    3. Methods of thinning
      a. Low thinning
        (1) Purpose
        (2) When applied
        (3) Advantages and disadvantages
        (4) Effect on stand growth and reproduction
      b. Crown thinning
        (1) Purpose
        (2) When applied
        (3) Advantages and disadvantages
        (4) Effect on stand growth and reproduction
      c. Selection
        (1) Purpose
        (2) When applied
        (3) Advantages and disadvantages
        (4) Effect on stand growth and reproduction
      d. Mechanical
        (1) Purpose
        (2) When applied
        (3) Advantages and disadvantages
        (4) Effect on stand growth and reproduction
      e. Free thinning
        (1) Purpose
        (2) When applied
        (3) Advantages and disadvantages
        (4) Effect on stand growth and reproduction
    4. Regulation of stand density through thinning
      a. Thinning schedule development—rotation periods
      b. Percent of stocking (stand density)

        - c. Spacing estimates
        - d. Economic thinning schedules
    - 5. Effect of thinning on forest protection—susceptibility vs. vulnerability
        - a. Insect
        - b. Disease
        - c. Fire
        - d. Wind damage
    - 6. Thinning relationship to various forest uses
        - a. Watershed value
        - b. Wildlife management
        - c. Recreation
- B. Laboratory Projects
    - 1. Take a field trip to a series of plantations or stands exhibiting high, low, selection, and mechanical thinning techniques. Discuss the advantages and disadvantages of each system as it pertains to the economics of harvesting and merchandising. Discuss disease and insect problems as they pertain to stand composition.
    - 2. Set up strips for student thinning in pre-commercial stands. Appoint two- or three-man crews. Allow the students to mark potential crop trees, trees to be removed in an intermediate thinning, and those to be removed immediately. Temporarily mark these trees with a lime sock.
    - 3. Have students thin the pre-commercial stand by hand axe or chain saw. Determine volume to be removed by basal area tabulation.
    - 4. Set up a selected area which has been thinned next to an unthinned area and have students classify a number of trees in both areas for vigor, crown classification, quality, and volume. Discuss harvesting and merchandising problems. Take increment borings to determine rate of growth.
    - 5. Have the students mark a stand for a commercial thinning. Compare these results with the pre-commercial operation in a biotic and economic sense.
    - 6. Write a report comparing these methods, stressing the economic and biotic relationships.

IV. Pruning
- A. Units of Instruction
    - 1. Natural pruning
        - a. Branch death and healing rate
        - b. Types of knots formed
            - (1) Unsound knots
            - (2) Sound knots
    - 2. Artificial pruning
        - a. Effects on tree
        - b. Species, size, and age of trees to prune
        - c. Height and number per acre
        - d. Economics involved
        - e. Methods
            - (1) Methods currently used
            - (2) Research progress
- B. Laboratory Projects
    - 1. Under field conditions, show and discuss natural pruning and the lack of it in various timber types. Discuss the formation of knots and knot-free lumber by having a series of sawn logs available, both pruned and unpruned.
    - 2. Have student crews select crop trees for pruning, keeping all silvicultural aspects in mind.
    - 3. Have students prune these selected crop trees after a thorough discussion and critique by the class and instructor.
    - 4. Require a report indicating the economic returns possible as well as the cost of pruning. Charts and graphs depicting the speed and cost of pruning various species should be included.

V. Regeneration of Forest Stands
- A. Units of Instruction
    - 1. Natural regeneration
        - a. Seed supply
        - b. Insects
        - c. Disease
        - d. Micro-environmental factors
            - (1) Soil temperatures
            - (2) Moisture requirements
    - 2. Artificial regeneration
        - a. Controlled seeding
            - (1) Control of seed eating birds and animals
            - (2) Site preparation and modification

        - (3) Seed sources and genetics
        - (4) Seed orchards and pollination
        - (5) Seed storage
        - (6) Seed treatment and testing
    - b. Methods of seeding
        - (1) Broadcast—aerial and ground
        - (2) Strip and spot seeding
    - c. Tree planting
        - (1) Adaptation of species to site requirements
        - (2) Selection and handling of planting stock
        - (3) Spacing
        - (4) Season of planting
        - (5) Site preparation
        - (6) Methods and economics of planting—hand and machine
    - d. Protection of new plantings
        - (1) Biotic causes of destruction
        - (2) Atmospheric causes of destruction
        - (3) Fertilization of plantations
- 3. Site preparation
    - a. Effects of logging slash
        - (1) Effects of slash on reproduction
        - (2) Slash effects on the soil
        - (3) Slash in relation to insects and disease
    - b. Disposal of slash
        - (1) Broadcast burning
        - (2) Spot burning
        - (3) Pile burning
        - (4) Lopping and scattering of slash
    - c. Seed bed preparation
        - (1) Prescribed burning
            - (a) Species affected
            - (b) Controlling competing vegetation
            - (c) Methods of burning
        - (2) Mechanical treatment
            - (a) Scarification by harrows and rakes
            - (b) Rolling brush cutters
            - (c) Brush rakes and anchor chains

B. Laboratory Projects

1. Make a field trip to see planting techniques by hand and machine. If possible, visit an area undergoing machine site preparation and prescribed burning. Have the resource person in charge discuss his reasons for doing this preparation as well as the economical aspects, methods, and results desired.
2. Prepare a seed lot for direct seeding by hand methods and, setting up crews of men, re-seed a selected area by hand.
3. Visit a direct seeding project in the locale and discuss site preparation, seed preparation, and seed distribution by aircraft. With the resource person discuss and demonstrate methods of seeding from aircraft.
4. Take a field trip to a forest nursery. Discuss and demonstrate seed certification, seeding, transplanting, lifting, sorting, bundling, and shipping.
5. Select a planting site and have the students plant a number of species by hand.
6. Present a report on the seeding and planting systems in the local area, discussing economics, species, site, and methods.

VI. Specialized Tree Production

A. Units of Instruction

1. Christmas tree production
2. Maple syrup and sugar production
3. Naval stores operation
4. Brush fern picking

B. Laboratory Projects

1. Visit a local Christmas tree farm and demonstrate or discuss planting or seeding, cultural practices, harvesting, and merchandising of Christmas trees.
2. Visit a local maple syrup industry; observe and discuss the phases of the operation.
3. Visit a local naval stores operation; observe and discuss the phases of the operation.
4. Require a report concerning all aspects of the items discussed and observed at the industry visited.

VII. Silvicultural Systems

A. Units of Instruction

1. Clearcut method
    - a. Clearcutting with artificial regeneration

   b. Clearcutting with natural regeneration
      (1) Advanced reproduction
      (2) Subsequent reproduction
   c. Methods of clearcutting
2. Seed tree method
   a. Number and distribution of seed trees
   b. Cultural operations
   c. Advantages and disadvantages of seed tree method
3. Shelterwood method
   a. Type of forest produced
   b. The shelterwood method
   c. Modifications of the method
      (1) Uniform system
      (2) Strip-shelterwood system
      (3) Group-shelterwood system
4. Selection method
   a. Basic procedure
   b. Form of stand produced
   c. Modifications of the method
      (1) Single tree selection
      (2) Group selection
      (3) Strip selection
   d. Advantages and disadvantages of the method

B. Laboratory Projects
1. Visit as many harvesting operations as possible in the local area, choosing selected areas exhibiting the various silvicultural cutting systems.
2. Conduct a thorough on-site discussion of the cutting system, method of marking, timber harvesting problems, economic and reproduction problems.
3. Require a report of each student on each of the systems discussed and shown. This report should indicate the best system to use by species in the local area as well as the economics involved.

VIII. Commercial Forest Regions of the United States

Units of Instruction
1. Northern coniferous forest
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
2. Mixed coniferous–deciduous broadleaf forest
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
3. Central hardwood forest (cove hardwoods)
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
4. Mixed coniferous–evergreen hardwood forest of the Southeastern United States
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
5. Coniferous forest of Rocky Mountain and Great Basin ranges, including inland empire
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
6. Chaparral and evergreen broadleaf forest of California
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
7. Coniferous forest of Sierra Nevada chain
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
8. Coniferous forest of the northern Pacific Coast
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management
9. Coniferous forest of Alaskan Coast
   a. Major commercial species
   b. Silvical characteristics
   c. Silvicultural management

Texts and References

BARRETT. *Regional Silviculture of the United States.*
HAWLEY and SMITH. *The Practice of Silviculture.*
SLOAN, SARGENT, and SARGENT. *Christmas Trees—A Cash Crop.*
SMITH. *The Practice of Silviculture.*
SOCIETY OF AMERICAN FORESTERS. *Forest Cover Types of North America.*
SOWDER. *Christmas Trees: The Tradition and the Trade.*
SPURR. *Forest Ecology.*
STANGEL. *Christmas Trees—A Technical Manual.*
U.S.D.A. FOREST SERVICE. *Silvics of Forest Trees of the United States.*
U.S.D.A. FOREST SERVICE. *Woody-Plant Seed Manual.*

Visual Aids

McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York, N.Y. 10036.

The Deciduous Forest. 28 minutes, 16 mm., color, sound.

Rarig's, Inc., Film Production Division, 5510 University Way, Seattle, Wash. 98105.

Reforestation. 14½ minutes, 16 mm., black and white, sound.

State Board of Education, Commonwealth of Virginia, Richmond, Va. 23200.

Pines From Seedlings. 20 minutes, 16 mm., black and white, sound.

State of Oregon, Department of Forestry, Salem, Oreg. 97310.

Tree Planting. 20 minutes, 16 mm., color, sound.

State University of New York, College of Forestry, Department of Forest Extension, Syracuse, N.Y. 13200.

A Tree Grows for Christmas. 11 minutes, 16 mm., black and white or color, sound.

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

Even-Aged Silviculture of Upland Hardwoods (In the Central States.) Slide-tape program, 139 slides.

TIMBER HARVESTING

Hours Required

Class, 2; Laboratory and/or Field, 6.

Course Description

An elementary course in timber harvesting methods, including the physical layout and economic, silvicultural, and protection considerations. Maintenance of logging tools and machinery is studied, with emphasis on foremanship and woods safety currently being practiced in the region. Special consideration is given transportation media, logging costs, and safety with new machines and methods currently being developed. The course includes a study of the application of safety methods in harvesting operations; the use of logging tools, equipment, and machinery; the non-engineering aspects of forest road location and layout; the basic skills and techniques of felling, bucking, limbing, and skidding; the application of harvesting plans, systems, and techniques to varying conditions; the harvesting costs; and the interrelationship between harvesting methods, silviculture, and general forest management.

Field trips are taken to local logging operations, and extensive field exercises involving various phases of logging are included in the laboratory and field part of the course. These practical exercises cover phases from the standing tree to log decking at the roadside and transportation.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Regional Harvesting Practices	1	4
II. Examples of Harvesting Crew Organizations	2	4
III. Planning the Timber Harvest	3	8
IV. Skidding Systems	9	30
V. Loading Methods	1	4
VI. Land Transportation	6	30
VII. Water Transportation	1	0
VIII. Costs and Records	9	16
Total	32	96

I. Regional Harvesting Practices
  A. Units of Instruction
    1. Harvesting practices in the major geographic regions of the United States will be discussed using the topics listed below:
      a. The forest
      b. Labor
      c. Felling and bucking
      d. Bunching and skidding
      e. Loading
      f. Transportation
    2. Northeast
    3. Southeast
    4. Lake States
    5. West
  B. Laboratory Projects
    1. Safety in harvesting timber crops
    2. Importance of safety
    3. Types of accidents
    4. Causes of accidents
    5. Personal clothing and equipment
    6. Safety devices for machinery, tools, and equipment
    7. A logging safety program
    8. First aid

II. Examples of Harvesting Crew Organizations
  A. Units of Instruction
    1. Pine sawlog harvesting operation in Louisiana
    2. Pine pulpwood operation in southern Georgia
    3. Unit of pulpwood production for many operations in Maine
    4. Tree-length pulpwood operation with a machine bucker in Maine
    5. Hardwood and hemlock sawlog harvesting operation in northern Michigan
    6. A northeastern Oregon pine operation
    7. An Alaskan operation
    8. A western Washington clear-cut Douglas fir operation

B. Laboratory Projects

Correct use of basic harvesting tools and equipment demonstrated and practiced:

1. Axe
2. Power saws
3. Wedges
4. Peavy and cant hook
5. Pulp hook
6. Logging chains and cable chokers
7. Wire rope

III. Planning the Timber Harvest

A. Units of Instruction

1. Harvesting–area data
   a. location and accessibility
   b. Distribution of timber and topography
2. Factors that influence the choice of operating method
   a. Size of product
   b. Daily and annual output required
   c. Volume per acre
   d. Labor
   e. Duration
   f. Integrated use
   g. Existing facilities
   h. Legal limitations
   i. Policy of owner
   j. Stand improvement
3. Type of operation possible

B. Laboratory Projects

1. Observe a small, local logging job showing the use of a small crawler with scoot and boom or a team of horses with scoot.
2. An alternative would be a demonstration of the planning that is done for the student logging operations. This would involve a brief introduction and the use of boundary survey maps, topographic maps, aerial photos. Road location and location of skid trails and landings in relation to volume per acre should be covered.

IV. Skidding Systems

A. Units of Instruction

1. Factors which influence the choice of system
   a. Production requirements
   b. Topography
   c. Products being harvested
   d. Economics
2. Cable systems
   a. High lead
   b. Skyline
   c. Modifications of the two main types
3. Crawler tractors
   a. Arch skidding
   b. Pan skidding–other anti-friction devices
   c. Scoot and boom; sled skidding
   d. Ground skidding; cable or chains; tongs
4. Rubber-tired and rubber-tracked vehicles
   a. Capabilities
   b. Makes of machines
   c. Choice of machines
5. Harvesting machines
6. Animals
7. Latest harvesting systems

B. Laboratory Projects

1. A demonstration and practical application of the correct procedures in felling timber.
   a. Sizing up the tree
   b. Making the undercut
   c. Making the backcut
   d. Use of wedges
   e. Effects of wind and topography
   f. Leaning and lodged trees
   g. Direction of fall based on terrain and logging system used
   h. Safety precautions
2. A demonstration and practical application of the correct procedures in bucking timber.
   a. Specifications and grade requirements for different products
   b. Log grades of different species
   c. Hardwood log grades
   d. Bucking procedure
   e. Trim allowance
3. A demonstration and practical application of several skidding techniques that can be used economically in the local area and on the student logging operation.
4. After the introduction of felling, bucking, and skidding techniques, students will continue to gain skill and be trained in the correct pro-

cedures while conducting a student logging job.

V. Loading Methods
A. Units of Instruction
1. Hand methods
2. Loggers' dream
3. Cross haul
4. Hydraulic loaders
5. Cranes and shovel loaders
B. Laboratory Project
Observe a medium-sized mechanized logging job showing mechanized skidding and loading operations.

VI. Land Transportation
A. Units of Instruction
1. Skid trails and landings
a. Locations
b. Maintenance
2. Logging roads
a. Purpose of the road—single or multiple
b. Locating the road
c. Soil and water protection
d. Maintenance and rights-of-way
e. Non-permanent bridges and culverts
3. Trucking
a. Types of trucks for logging
b. Legal limitations and acquirements
c. Trucking costs
4. Logging railroads
B. Laboratory Projects
1. Execute a small, practical problem involving the location of a logging road in relation to skid trails, landings, drainages, and volume of timber.
2. Build a small bridge out of local materials.
3. Build a box culvert for drainage.
4. Lay out a short stretch of logging road to include flagging, swamping out, and rough grading. Layout would involve the use of the Abney level and hand compass.
5. Take a trip to a log trucking garage and have the manager explain the various factors that must be considered in equipping a truck for hauling logs.

VII. Water Transportation
Units of Instruction
1. River driving
2. Barging
3. Rafting
4. Fluming

VIII. Costs and Records
A. Units of Instruction
1. Machine rate calculations
2. Cost factors of harvesting timber
a. Felling and bucking
b. Skidding
c. Loading
d. Trucking
e. Overhead
f. Management costs
3. Time and cost studies of a harvesting operation
4. Cost analysis of the tools, equipment, and various phases of logging
B. Laboratory Projects
1. Observe a large, integrated logging operation showing rubber-tired skidders, crawlers, hydraulic and crane loaders, woods camp, logging roads, and all other phases of a jobber or company-operated harvesting operation.
2. Conduct time studies on a local logging job, collecting enough data to have a cost analysis of the different steps involved in a timber harvesting operation.

Texts and References

ALLIS-CHALMERS COMPANY. *Fundamentals of Logging.*
AMERICAN PULPWOOD ASSOCIATION. *Pulpwood Truck Driving.*
AMERICAN PULPWOOD ASSOCIATION. *Small Crawler Operator's Manual.*
COBB. *Skidding With Rubber-Tired Tractors in the Tennessee Valley.*
DARWIN. *Logging Facts for Sawmill Operators.*
DONNELLY. "A Technique for Relating Logging Costs to Logging Chances."
FORBES. *Forestry Handbook.*
JILES. *Hardwood Logging Methods and Costs in the T.V.A.*
MCCRAW. "Relative Skidding Production of Track and Wheel Skidders."
MERZ *and others. Estimating Log-Making Costs in the Central States.*
SIMMONS. *Northeastern Loggers' Handbook.*
U.S.D.A. FOREST SERVICE. *Permanent Logging Roads for Better Woodlot Management.*

WACKERMAN. *Harvesting Timber Crops.*

WHEELAND. *Bibliography of Timber Products Harvesting in Eastern United States and Canada.*

WINER. "Multi-Product Logging Opportunities and Problems."

Audio-Visual Aids

American Pulpwood Association, 605 Third Avenue, New York, N.Y. 10016.

Pulpwood Logging. 23½ minutes, 16 mm., color, sound.

Brown Company, Woodlands Division, 650 Main Street, Berlin, N.H. 03570.

The Forest and the Woodsman. 30 minutes, 16 mm., color, sound.

Canadian Pulp and Paper Association, 2280 Sun Life Building, Montreal 2, Canada.

Logging Systems and Machines Concepts. 25 minutes, 16 mm., color.

Deere and Company, Moline, Ill. 61265. Request from nearest John Deere dealer.

Increasing Your Profit in Logging (northeast version, southeast version). 22 minutes, 16 mm., color, sound.

Forest Products Accident Prevention Association, 90 Harbour Street, Toronto, Ontario, Canada.

Bushmaster. 10 minutes, 16 mm., color, sound.

Chain Saw Safety Pays Off. 25 minutes, 16 mm., color, sound.

Horse Sense. 10 minutes, 16 mm., color, sound.

Garrett Enumclaw Company, 800 Stevenson Avenue, Enumclaw, Wash. 98022.

Tree Farmer Tractor. 24 minutes, 16 mm., color, sound.

Hiab Hydraulics, Inc., 3410 Lancaster Pike, Wilmington, Del. 19800.

Road Transport. 16 mm., color, sound.

Pettibone-Mulliken Corporation, 4700 West Division Street, Chicago, Ill. 60600.

Cary Lift on Pulpwood and Logging. 16 mm., color, sound.

Pettibone Master 12 Skidder. 15 minutes, 16 mm., color, silent.

Rarig's Inc., Film Production Division, 5510 University Way, Seattle, Wash. 98105.

Falling and Bucking Timber. 15 minutes, 16 mm., color, sound.

Hauling Logs. 23 minutes, 16 mm., color, sound.

Yarding Logs. 21 minutes, 16 mm., color, sound.

U.S.D.A. Forest Service, Center Building, 6816 Market Street, Upper Darby, Pa. 19082.

Easier Ways of Logging. 26 minutes, 16 mm., color, sound.

ADVANCED FOREST SURVEYING

Hours Required

Class, 1; Laboratory and/or Field, 6.

Course Description

A course designed to follow *Elementary Forest Surveying*. The operation of the more precise engineering instruments and their application to forestry problems are developed, including the ability to compute problems often confronted when using these instruments.

Engineering levels, transits, and plane tables and alidades are the major pieces of equipment studied. The proper care, minor adjustments, and correct handling of these instruments is covered as well as the advantages and disadvantages of any one piece of equipment for a particular task.

At least two-thirds of the total laboratory time should be spent in the field, with students operating surveying instruments in practical problem assignments. Field books should be kept by each student and correctly filled in for all field work. All books should be collected immediately after an outside assignment and graded by the instructor for neatness, clarity, completeness, and adherence to normal surveying practices. Problems involving the study and use of horizontal and vertical curves, and area and volume computations are developed and solved in indoor laboratories. The relationship between data collected in the field and its use in office computation should be stressed.

Major Divisions

	Hours	
	Class	Laboratory and/or field
I. Engineering Level	3	18
II. Transit	6	36
III. Plane Table and Alidade	2	12
IV. Stadia	1	6
V. Curves	2	12
VI. Computing Areas and Volumes	2	12
	—	—
Total	16	96

I. Engineering Level
  A. Units of Instruction
    1. General
      a. Definition of terms
      b. Theory
      c. Methods
      d. Types of instruments
      e. Level rods
      f. Verniers
      g. Operation of levels
    2. Differential leveling
      a. Definitions
      b. Operation
      c. Field book
    3. Profile leveling
      a. Definitions
      b. Cross sections
      c. Field book
    4. Level circuits
      a. Precision
      b. Adjustment
      c. Sources of error
      d. Problems
  B. Laboratory and/or Field Project
    1. With the use of an engineering level, level rod, ribbon tape, and stakes, determine if the line of sight of the level is parallel to the axis of the bubble tube.
    2. With the use of an engineering level and allied equipment, complete a bench mark survey. Record all pertinent data in a field book to be checked by the instructor.
    3. With the use of a level and allied equipment, acquire field data for a profile plan and also for cross section plans at each full station.
    4. With the use of a level and allied equipment, set slope stakes for a road bed.

II. Transit
  A. Units of Instruction
    1. General
      a. Types
      b. Parts
      c. Verniers
      d. Handling

2. Operation
   - a. Measuring direct angles
   - b. Laying off angles
   - c. Deflection angles
   - d. Azimuths
   - e. Prolonging a straight line
   - f. Random lines
   - g. Laying out curves
   - h. Problems

3. Traversing
   - a. Open traverses
   - b. Closed traverses
   - c. Field party
   - d. Notes
   - e. Closure
   - f. Problems

B. Laboratory and/or Field Projects

1. With the use of a transit and other necessary equipment, run a straight line for several hundred feet with a minimum of four instrument setups. Record information in field book and have straightness of the line checked by the instructor.
2. With a transit and other equipment, set stakes in the shape of a triangle and compute the length of one side using triangulation. Check the computed length by taping, and record all information in field book.
3. Run a complete traverse, measuring interior, exterior, and deflection angles at each of the transit stations. Record information in field book.
4. Locate the center line for a forest haul road, setting stakes at each full station. Set slope and grade stakes and recommend locations for erosion control structures. Record all information in field book.
5. Lay out a horizontal curve for a log haul road using a transit and other equipment.
6. Locate the proper places for foundation forms for a building with the aid of a transit. Record information in field book.

III. Plane Table and Alidade

A. Units of Instruction

1. Telescopic Alidade
   - a. Operation
   - b. Traversing
   - c. Advantages
2. Peepsight Alidade
   - a. Operation
   - b. Traversing
   - c. Problems

B. Laboratory and/or Field Projects

1. With a telescopic alidade and plane table, make a topographic map of a specified field area.
2. Plot a closed traverse of a designated area and also include topographic features with the aid of an alidade and plane table.
3. With an alidade and plane table, map the necessary natural features for a preliminary campsight investigation showing contour lines, vegetation, and locations of ponds and streams.

IV. Stadia

A. Units of Instruction

1. Theory
2. Horizontal sights
3. Inclined sights
4. Stadia rod
5. Beaman arc
6. Problems

B. Laboratory and/or Field Project

Using a transit and stadia rod, traverse a given area, recording angles and distances. Check distances obtained by stadia with engineer's tape. Record information in field book.

V. Curves

A. Units of Instruction

1. Horizontal curves
   - a. General
   - b. Formulas
   - c. Examples
   - d. Problems
2. Vertical curves
   - a. General
   - b. Examples
   - c. Problems

B. Laboratory Projects

1. With given information from a text or other source, work problems in the area of horizontal curves from the designing of the curve through the necessary computations for field layout.

2. With given problem information, compute the necessary data for field layout of vertical curves.

VI. Computing Areas and Volumes
  A. Units of Instruction
    1. Areas
      a. Triangles
      b. Offsets
      c. Simpson's ⅓ Rule
      d. Trapezoidal Rule
      e. Polar planimeters
      f. Dot grid methods
    2. Volumes
      a. Average end area
      b. Prismoidal formula
  B. Laboratory Projects
    1. With profile paper, plot the profile of a log haul road, using data from a previous outdoor laboratory project. In designing the road, stay within allowable slopes for safety and economy.
    2. Plot cross sections of a typical log haul road (such as No. 1 above) and determine the volume of cut and fill necessary to construct the road.
    3. Plot a traverse from field data or a text and compute the area enclosed, using the offset rule, the Simpson's ⅓ Rule, and the Trapezoidal Rule.

Texts and References

Boucher *and* Moffit. *Surveying.*

Breed. *Surveying.*

Brinker *and* Taylor. *Elementary Surveying.*

Brown. *Boundary Control and Legal Principles.*

Brown *and* Eldridge. *Evidence and Procedure for Boundary Location.*

Davis. *Elementary Plane Surveying.*

Fogel. *Introduction to Engineering Computations.*

Kissam. *Surveying.*

Low. *Plane Table Mapping.*

Meyer. *Route Surveying.*

Pafford. *Handbook of Survey Notekeeping.*

U.S.D.A. Forest Service. Division of Engineering. *Road Handbook.*

OUTDOOR RECREATION

Hours Required

Class, 1; Laboratory and/or Field, 6.

Course Description

An introductory course in outdoor recreation. The major kinds of outdoor recreation, the supply and demand for them and their economic possibilities, the recreational use of forest resources, and the psychology of recreation are studied. The importance of forest recreation and its relationship to other forest uses and the organization and administration of forest land for recreational purposes are considered. Planning and design of recreational areas, and the simple kinds of structures for picnic tables, fireplaces, and other recreational facilities are studied.

Field trips to local recreational areas and practical field exercises in the development, construction, and maintenance of facilities at an area provide practical field experience. This course emphasizes the fact that outdoor recreation is a business. Students select and develop a detailed recreation plan for an undeveloped forest area.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Leisure and the Demand for Outdoor Recreation	1	12
II. Kinds of Outdoor Recreational Enterprises	3	12
III. Campgrounds, Picnic Areas, and Sports Areas	3	6
IV. Selecting the Recreational Enterprise	2	12
V. Implementing Plans and Developing the Recreational Enterprise	1	39
VI. Maintaining and Operating the Enterprise	2	9
VII. Managing Recreational Enterprises	2	3
VIII. Technical and Financial Assistance Available	1	0
IX. Merchandising Recreational Activities	1	3
Total	16	96

I. Leisure and the Demand for Outdoor Recreation
- A. Units of Instruction
  - 1. Leisure—basic in the culture of man
  - 2. Demand for outdoor recreation
    - a. Findings of the Outdoor Recreation Resources Review Commission, 1962
    - b. Local situation
  - 3. Survey of available outdoor recreational facilities within the region
    - a. National parks and forests
    - b. State parks and forests
    - c. Private enterprises
- B. Laboratory Projects
  - 1. Make a field trip to a National park.
  - 2. Make a field trip to a National forest recreation area.
  - 3. Make a field trip to a State park.
  - 4. Make a field trip to several private outdoor recreational enterprises.

II. Kinds of Outdoor Recreational Enterprises
- A. Units of Instruction
  - 1. Demand for
    - a. Fishing areas
    - b. Hunting areas
    - c. Shooting preserves
    - d. Scenic, historic, and natural areas
    - e. Winter sports areas
    - f. Land-use rights
    - g. Cabin sites
  - 2. Income potentials for recreational enterprises such as those listed above
  - 3. Sources of additional income, such as:
    - a. Boat rental, bait and tackle sales, and rentals for fishing areas
    - b. Guide services, cabin rentals for hunting areas

    - c. Kennels, shooting range, game sales for shooting preserves
    - d. Lodge, snack bar, horse rental for scenic and natural areas
    - e. Ski lessons, rental of snow mobiles for winter sports areas
  - 4. Special requirements for recreational enterprises such as those listed above
  - 5. Management of recreational enterprises such as those listed above
  - 6. Special problems
    - a. Weed control and fish management for fishing areas
    - b. Game and wildlife habitat for hunting areas
    - c. Licensing and State game regulations for shooting preserves
    - d. Vandalism in natural, historic, and scenic areas
    - e. Lack of snow in winter sports areas
    - f. Zoning for land-use rights
    - g. Building permits for cabin sites
- B. Laboratory Projects

  Make field trips to several local, private, outdoor recreational enterprises such as shooting preserves, fishing areas, and winter sports areas.

III. Campgrounds, Picnic Areas, and Sports Areas

- A. Units of Instruction
  - 1. Contrast the philosophy of the National parks, National forests, State parks, and private enterprises as reflected by campground, picnic, and sports area development
  - 2. Demands for campgrounds, picnic, and sports areas on
    - a. National parks
    - b. National forests
    - c. State parks
    - d. Private forest enterprises
  - 3. Income potential for each of the above
  - 4. Requirements peculiar to each of the above
  - 5. Management peculiar to each of the above
- B. Laboratory Projects
  - 1. Have a guest speaker explain to the class the organization of his agency and the philosophy of the organization as it pertains to outdoor recreation and land use.
  - 2. Make a field trip to study the facilities and managerial aspects of a private or public campground. Resource personnel are used extensively on field trips of this nature to present to the student the agency's policies on developing and managing campgrounds.

IV. Selecting the Recreational Enterprise

- A. Units of Instruction
  - 1. Land ownership and land use
  - 2. Evaluation of potential land use
  - 3. Reconnaissance
    - a. Maps
    - b. Aerial photographs
    - c. Ground survey
  - 4. Selection of a site for a campground
    - a. Physical features
      - (1) Water
      - (2) Topography
      - (3) Potable water
      - (4) Vegetation
      - (5) Natural attractions
      - (6) Vista
      - (7) Forest pests
      - (8) Animal and bird life
      - (9) Climate and microclimate
    - b. Socio-economic factors
      - (1) Geographic location
      - (2) Economic and business management
      - (3) Proposed campground facilities
- B. Laboratory Projects
  - 1. Make a rating of an existing successful campground based on physical and socio-economic factors.
  - 2. Make a similar rating of an undeveloped campground site and compare the rating with the above.
  - 3. Delineate on existing maps and aerial photos the boundaries of a proposed campground, paying close attention to topographic and vegetative features.

V. Implementing Plans and Developing the Recreational Enterprise

- A. Units of Instruction
  - 1. Outdoor recreation in the forest management plan
  - 2. Detailed mapping of an undeveloped

campground area
    3. Actual campground layout using detailed plans as provided
        a. Location of camp sites
            (1) Tent or trailer site
            (2) Parking area
            (3) Picnic table
            (4) Fireplace
        b. Location of roads
        c. Location of improvements
            (1) Sanitation facilities
            (2) Potable water facilities
            (3) Barriers and entrance gates
            (4) Directional signs
            (5) Trails and paths
            (6) Other buildings
B. Laboratory Projects
    1. Survey and prepare a topographic map of a campground area.
    2. Relate features on the ground to points on this map.
    3. Grade stake a sewer and/or water system in the campground in compliance with local health and sanitation regulations.
    4. Locate and develop self-guided nature trails.
    5. Construct tent sites and parking areas, using different size requirements.
    6. Construct picnic tables and fireplaces, using different designs.

VI. Maintaining and Operating the Enterprise
A. Units of Instruction
    1. Sanitation
        a. Sewerage
        b. Refuse disposal
        c. Vermin control
    2. Water supply
    3. Electric supply
    4. Vegetation control
    5. Vegetation establishment
    6. Public relations
        a. Rules and regulations
        b. Attitude and goodwill of employees
        c. In-service training of employees
    7. Customer relations
        a. Registering of guests
        b. Hospitality
B. Laboratory Projects
    1. Make a field trip to a sewage disposal plant.
    2. Demonstrate the formulation and application of an appropriate insecticide for comfort control.
    3. Demonstrate the use of specialized tree expert equipment.

VII. Managing Recreational Enterprises
A. Units of Instruction
    1. Business management procedures
    2. Available capital for development and operation
    3. Tax assessment and structure
    4. Public relations with consumers and in the community where the facility is located
    5. Competition
        a. Favorable
        b. Unfavorable
    6. Legal restrictions
        a. Zoning regulations
        b. Water and sanitation regulations
        c. Fire regulations
        d. Law enforcement regulations
B. Laboratory Projects
    1. View and discuss management procedures with a public or private recreational enterprise.
    2. Review the management requirements of an established recreational enterprise, paying particular attention to legal restrictions dictated by the local government in which the business is located.

VIII. Technical and Financial Assistance Available
Units of Instruction
    1. The Bureau of Outdoor Recreation
    2. The Soil Conservation Service
    3. The Forest Service
    4. The Farm Home Administration
    5. The Cooperative Extension Service
    6. Others

IX. Merchandising Recreational Activities
A. Units of Instruction
    1. Publicity, promotion, and advertising
    2. Brochures
B. Laboratory Projects
    1. Design and write a brochure for a hunting area.

2. Write advertising copy for an outdoor recreational enterprise.

Texts and References

Allison *and* **Leighton.** *Evaluating Forest Campground Sites.*

Brockman. *Recreational Use of Wild Land.*

Clawson. *Land and Water for Recreation.*

Delphendahl. *Outdoor Recreation in Maine.*

U.S.D.A. Farmers' Home Administration. *Handbook of Outdoor Recreation Enterprises in Rural Areas.*

U.S.D.A. Forest Service. *Campgrounds for Many Tastes.*

U.S.D.A. Forest Service. *Forest Recreation for Profit.*

U.S.D.A. Forest Service. *Recreation Opportunities and Problems in the National Forests of the Northern and Intermountain Regions.*

U.S.D.A. Forest Service. *Working Drawings of Basic Facilities for Campground Development.*

U.S.D.I. Bureau of Outdoor Recreation. *Federal Assistance in Outdoor Recreation.*

U.S.D.I. Bureau of Sport Fisheries. *National Survey of Fishing and Hunting, 1965.*

U.S.D.I. Outdoor Recreation Resources Review Commission. *Outdoor Recreation for America.*

U.S.D.H.E.W. Public Health Service. *Manual of Septic Tank Practice.*

University of Vermont. *How To Develop a Campground.*

Wilson. *Family Camping Manual.*

FOREST PRODUCTS UTILIZATION

Hours Required

Class, 2; Laboratory and/or Field, 6.

Course Description

An introductory course in forest products utilization. The objectives of this course are to give the students an appreciation of how wood is utilized so they may better understand forestry practices. The use of different wood species for various products is stressed. The reasons why woods have extreme ranges in value and utility are demonstrated by studying the multitude of products manufactured. Log grades and lumber grades are correlated and studied in depth by the practical application of grading rules.

Lumber manufacturing, mechanization, automation, material flow, productivity, and costs are studied. Quality control of the manufactured product is introduced and discussed.

Utilization of waste generated in the wood manufacturing process is studied in depth. This includes general problems associated with the product, quantities of waste material produced, machinery required for conversion to a useable product, machinery costs, conversion costs, handling and transportation, and the available markets.

The accepted techniques of handling, seasoning, and storing lumber are introduced, including air-drying and kiln-drying practices. Preservation of wood is introduced to give the students an appreciation of how the useful life of wood may be economically extended.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Primary Wood Products	1	4
II. Manufacturing Processes Other Than Lumber	3	8
III. Lumber Grading	4	12
IV. Lumber Manufacturing	4	18
V. Evaluating the Manufacturing Process	4	10
VI. Utilization of Wood Waste	4	8
VII. Quality Control in the Manufacturing Process	4	12
VIII. Seasoning Lumber	5	16
IX. Wood Preservation	3	8
Total	32	96

I. Primary Wood Products
  A. Units of Instruction
    1. Sawlogs
    2. Veneer logs
    3. Pulpwood
    4. Boltwood
    5. Posts, poles, and piling
    6. Tie logs and mine timbers
    7. Firewood
    8. Specialty products
  B. Laboratory Projects
    1. Make a field trip to a multi-product harvesting operation to study the opportunities and problems in producing different products at their source.
    2. Make a field trip to a concentration yard containing two or more different wood products; discuss, observe, and study the techniques of operating such a yard.

II. Manufactured Products Other Than Lumber
  A. Units of Instruction
    1. Boxboard
    2. Cooperage
    3. Turnings
    4. Dimension squares
    5. Pallets
    6. Veneer and plywood
    7. Furniture
    8. Pulp and paper
    9. Particle and flakeboard
    10. Specialty products
      a. Pencils
      b. Matches
      c. Toothpicks
      d. Excelsior

B. Laboratory Project

Make field trips to at least two of the above named industries to study their manufacturing procedures. Emphasis should be placed on source and use of wood as a raw material, competitiveness with other materials, economics of the operation, problems associated with the industry, including merchandising and marketing the product.

III. Lumber Grading

- A. Units of Instruction
  1. Use classification
  2. Size classification
  3. Product classification
  4. Grading rules for softwood lumber
  5. National Hardwood Lumber Association Rules
- B. Laboratory Projects
  1. Conduct a practical exercise on grading softwood lumber.
  2. Conduct a practical exercise on grading hardwood lumber.
  3. Give a practical examination on grading hardwood and softwood lumber.
  4. Give a written examination on the lumber grading rules.
  5. Make a field trip to observe lumber being graded by a certified hardwood or softwood lumber inspector.
  6. Have a certified lumber grader conduct a practical exercise on grading lumber.
  7. Require a written or verbal evaluation of the industry visited.

IV. Lumber Manufacturing

- A. Units of Instruction
  1. Historical development
  2. Economic importance
  3. Kinds of sawmills
  4. Sawmill machinery
  5. Sawmill layout
  6. Principles of sawing
  7. Changing sawmill industry
     - a. Demand for lumber
     - b. Portable vs. stationary
     - c. Size of mills
     - d. Machinery
     - e. Log supply and methods of procurement
- B. Laboratory Projects
  1. Conduct a log scale–lumber tally comparison at a sawmill, preferably one owned by the institution. The objective of this exercise is to increase the student's ability to scale logs accurately. A minimum of 50 to 100 logs should be scaled.
  2. Conduct a log grade–lumber grade study at a sawmill, preferably one owned by the institution. The objective is to have the student become proficient in grading logs and lumber.
  3. Take field trips to small, medium, and large sawmills. The mills should be varied as to types—portable and stationary; kinds—circular, band, or sash gang; and should show an extreme variation in the amount of machinery and equipment incorporated in the manufacturing process. Require an oral or written evaluation of the sawmills visited.
  4. Conduct a field study of the techniques of hardwood grade sawing. Hardwood logs should be studied, graded, and observed while being sawn; the lumber should be graded separately for each log, correlating the log grade with the lumber grade.

V. Evaluating the Manufacturing Process

- A. Units of Instruction
  1. Efficiency in production
  2. Production costs
  3. Non-productive time—delay time
  4. Kinds and arrangement of machinery
     - a. Effect on production
     - b. Effect on efficient flow of materials
  5. Mechanization
  6. Automation
- B. Laboratory Projects
  1. Conduct a time study to collect data on the various processes required to manufacture lumber. This could also be done with other manufacturing processes.
  2. Use the collected data to make a cost analysis of the operation; graphical presentation of the data should be required.

- VI. Utilization of Wood Waste
  - A. Units of Instruction
    - 1. Pulp chips
      - a. History of pulp chipping program
        - (1) Producer's viewpoint
        - (2) Consumer's viewpoint
      - b. Factors influencing volume of waste produced
      - c. Debarking logs, slabs, and edgings
        - (1) Type of debarkers
        - (2) Cost of owning and operating
        - (3) Case examples
      - d. Cost of owning and operating a chipper
      - e. Possibilities of chipping low valued lumber and short logs
    - 2. Fuels
      - a. Heating plant and/or drying lumber
      - b. Generating electricity
      - c. Local firewood market
    - 3. Hogged wood
      - a. Wood composition markets
      - b. Mulch
      - c. Animal bedding
    - 4. Bark
  - B. Laboratory Projects
    - 1. Make a time study of the handling of waste material either at the institution's mill or at a production mill. Practical experience should be gained in handling and disposing of wastes generated in the manufacture of lumber.
    - 2. Visit a centralized chipping plant to study and observe the operating procedures. Pertinent information on the costs of operating and maintaining the facility should be acquired as well as on the procurement and marketing problems.
    - 3. Visit a lumber manufacturing plant that has a chipper; contrast this with a centralized chipping plant.
    - 4. Visit a plant that utilizes its waste in a manner other than chipping, such as fuel or composition board markets. Require an oral or written evaluation of the facilities studied.
- VII. Quality Control in the Manufacturing Process
  - A. Units of Instruction
    - 1. Function and purpose
    - 2. Statistical basis
    - 3. Control charts and bar graphs
    - 4. Analysis of chart data
    - 5. Usefulness of charts
  - B. Laboratory Projects
    - 1. Collect quality control data at the institution's sawmill or one producing in the area; lumber thickness, length, width, or some other measure of quality may be made.
    - 2. Construct control charts and bar graphs from the data collected in the previous laboratory.
    - 3. Analyze the charts and graphs to determine if the manufacturing process is in control. If not, determine what caused the process to be out of control and how it may be brought under control. If the sawmill owned by the institution is studied, a practical laboratory may be conducted to correct the faulty manufacturing process.
- VIII. Seasoning Lumber
  - A. Units of Instruction
    - 1. Air-drying lumber
      - a. Objectives
      - b. Principles
      - c. Site selection
      - d. Yard layout
      - e. Pile foundations
      - f. Methods of piling
      - g. Air-drying defects and their control
    - 2. Kiln-drying lumber
      - a. Kiln types and construction
      - b. Relation of temperature, relative humidity, air circulation, and equilibrium moisture content
      - c. Kiln schedules
      - d. Kiln samples
      - e. The complete kiln run
      - f. Equalizing and conditioning treatments
      - g. Special problems associated with drying various species
  - B. Laboratory Projects
    - 1. Give a demonstration of and have the students practice the correct stacking techniques.
    - 2. Visit an air-drying yard which prac-

tices the correct seasoning procedures and which has a good yard layout.

    3. Visit an air-drying yard which does not practice the correct drying procedure; make a simple study to determine loss in value due to improper seasoning practices.
    4. Conduct a practical kiln-drying exercise on a sample load of lumber, assuming the institution owns a small drying cabinet or a larger capacity kiln. Various species and thicknesses should be dried to give the student practical experience in these problem areas.
    5. Visit a kiln-drying facility to observe the procedures used and the problems involved in kiln-drying lumber.
    6. Conduct a simple cost study on kiln-drying both air-dried and green lumber.

IX. Wood Preservation

  A. Units of Instruction
    1. Introduction
    2. Natural durability of wood
    3. Wood preservatives
      a. Oils and oil-borne preservatives
      b. Water-borne preservatives
      c. Patented preservatives
    4. Preparing timber for treatment
    5. Wood preservative processes
      a. Non-pressure methods
      b. Pressure methods
  B. Laboratory Projects
    1. Dip-treat posts, lumber, and other small products in the facility owned by the institution.
    2. Visit a wood preservation plant to observe and study the products being treated and the method of treatment used.
    3. Conduct a simple in-service study of treated material.
    4. Visit a research study on preservative plots at a nearby institution (if available) and make a written or oral evaluation of the study.

Texts and References

Brown *and* **Bethel**. *Lumber.*

Butler. "Chip Markets: Potentials and Problems for Sawmills and Plywood Plants."

Church. *Railroad Crossties—Opportunities for Improving the Manufacture and Serviceability.*

Cuppett. *Air-Drying Practices in the Central Appalachians.*

Cuppett. *How To Determine Seasoning Degrade Losses in Sawmill Lumberyards.*

Dowdle *and* **Bain**. *Lumber or Chips?*

Field. "Types and Arrangement of Equipment and Its Affect on Grade Recovery."

Gillies. "Comments on Some of the Factors Affecting the Grade and Quality of Lumber Production."

Hamlin *and others*. "The Pulp Chipping Program in the Northeast."

Heebink *and* **Fobes**. *Hardwood Pallet Manufacturing.*

Hooker. "Techniques of Sawing for Grade Recovery."

Lehman. *The Changing Sawmill Industry.*

Lehman. *Utilizing Pine Sawmill Residue for Pulp Chips.*

Lewis. "Wood Residue Utilization."

Lockard *and others*. *Grade Defects in Hardwood Timber and Logs.*

Malcolm. *What Has Research Done for the Sawmill?*

Morgan. *Wood Chips from Sawmill Residues.*

National Hardwood Lumber Association. *An Introduction to the Grading and Measurement of Hardwood Lumber.*

National Hardwood Lumber Association. *Rules.*

National Wooden Pallet Manufacturers Association. *Specifications and Grades for Warehouse, Permanent or Returnable Pallets.*

National Wooden Pallet Manufacturers Association. *Specifications and Grades for Warehouse, Permanent or Returnable Pallets of West Coast Woods.*

Niskala *and* **Church**. *Cutting Hardwood Cants Can Boost Sawmill Profits.*

Northeastern Lumber Manufacturers Association. *Standard Grading Rules for Northern White Pine.*

Panshin *and others*. *Forest Products.*

Peck. *Air-Drying Lumber.*

Row *and others*. *Improving Sawmill Profits Through Operations Research.*

Schmidt. "Lumber—Quality? Grade?" Part I.

Schmidt. "Lumber—Quality? Grade?" Part II.

Telford. *Small Sawmill Operator's Manual.*

U.S.D.A. Forest Service. *A Guide to Hardwood Log Grading.*

U.S.D.A. Forest Service. *Wood . . . Colors and Kinds.*

U.S.D.A. Forest Service, Forest Products Laboratory. *Wood Handbook.*

Verrall. *Preserving Wood by Brush, Dip, and Short-Soak Methods.*

Whittaker. *A Cost-Accounting System for Small Sawmills.*

Whittaker *and* **McCauley**. *Costs and Returns for Hardwood Lumber Production in the Appalachian Region of Kentucky and Ohio.*

Visual Aids

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

Hardwood Grade Sawing. A slide-tape program. 89 slides.

FOREST PROTECTION

Hours Required

Class, 2; Laboratory and/or Field, 3.

Course Description

A course in forest protection, including a study of forest diseases, insects, and fire control. The more important insects and tree disease-causing organisms in the region are considered. Control methods employed against forest insects and diseases are discussed. More emphasis is placed on the identification of the insect and disease organisms and their effect on the forest environment than on control methods.

An overall view of the major forest disease problems is discussed, and the current research being conducted to reduce timber losses from these agencies is considered. Pathological terms are introduced to give the student a working basis for understanding the literature and a vocabulary with which to communicate about the subject. Classification and identification of the more important tree diseases and their resultant damage are studied. Emphasis is placed on associating and identifying the sporophores of major rot-causing fungi.

The classification, structure, identification, and development of insects are studied. Special emphasis is placed on learning about the destructive insects that cause the major portion of damage to forest trees. Recognition of damage and the association of the causal insect are emphasized. Ecological and control factors are introduced, but not covered in depth.

Fire control is covered by discussing fire prevention, presuppression, and suppression techniques and the basic principles of forest fire behavior. Considerations of the effects which fuel, weather, and topography have on forest areas are presented. Planning and organizing presuppression methods and implementing suppression techniques used by State, Federal, and private organizations to combat fires are covered in depth.

Note: The weight of emphasis to be placed on the protection of forests from disease, insects, or fire will vary from region to region. The course content should be weighted to provide the appropriate emphasis for each region.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Important Tree Disease Problems	1	0
II. Introduction, Terminology, and Classification of Tree Diseases	2	6
III. Study and Recognition of Major Rot-Causing Fungi	2	4
IV. Decays, Discolorations, and Logging Wounds in Hardwoods	2	4
V. Study of Important Rust, Stem, Foliage, and Root Diseases	3	2
VI. Introduction to Insects	1	0
VII. Classification, Structure, and Development of Insects	5	2
VIII. Forest Insect Damage	2	6
IX. Insect Control Measures	1	4
X. Regional Survey of Forest Insect Pests of Economic Importance	1	4
XI. Introduction to Fire Protection and Control	1	0
XII. Fire Prevention Planning	2	4
XIII. Fire Behavior and Effects	2	3
XIV. Fire Prevention and Presuppression Measures	2	3
XV. Suppression Measures	5	6
Total	32	48

I. Important Tree Disease Problems

Units of Instruction

1. Why study tree diseases

2. Areas of emphasis in forest disease research
3. Disease priorities
   a. High
   b. Medium
   c. Low

II. Introduction, Terminology, and Classification of Tree Diseases
- A. Units of Instruction
  1. Review of important tree diseases to be studied
  2. Explanation of disease terminology
  3. Classification of tree diseases
     a. Causal organisms
     b. Symptoms
     c. Hosts
     d. Part of plant infected
- B. Laboratory Projects
  1. If the season of the year permits, conduct a field trip to locate, observe, and field identify, if possible, some of the more important seedling, shade, or forest tree diseases. Concentrate on symptoms and signs of diseases other than rot-causing fungi.
  2. Identify and discuss sample collections of tree diseases that cannot be seen under actual field conditions.
  3. Have a recognized pathologist give a slide-lecture presentation of tree and seedling diseases. This may include the more important shade tree diseases.

III. Study and Recognition of Major Rot-Causing Fungi
- A. Units of Instruction
  1. Introduction to fungi
  2. Classification of fungi
  3. Symptoms and signs of the more important rot-causing fungi
     a. *Fomes annosus*
     b. *Fomes pini*
     c. *Fomes pinicola*
     d. *Fomes fomentarius*
     e. *Fomes applanatus*
     f. *Fomes ignarius*
     g. *Polyporus betulinus*
     h. *Polyporus balsameus*
     i. *Polyporus schwentzii*
     j. *Poria obliqua*
- B. Laboratory Projects
  1. Schedule a field trip to locate, study, and collect some of the more important rot-causing fungi. Emphasis should be placed on the recognition, association, and extent of rot as indicated by external signs of the sporophore and symptoms on the tree.
  2. An indoor laboratory exercise should include a study of sporophores for identification and an explanation given on the damage associated with them.

IV. Decays, Discolorations, and Logging Wounds in Hardwoods
- A. Units of Instruction
  1. Internal defects associated with pathogenic organisms
  2. Infection counts on living trees
  3. Causal organisms of decays and discolorations
  4. How succession of organisms moves in living trees
  5. Confinement of decay column at time of wounding
  6. Physiologically normal heartwood compared to pathological heartwood
- B. Laboratory Projects
  1. Visit a pathology laboratory to see and have explained the procedure used for isolating and culturing pathogenic organisms. Extensive dissections of tree samples, properly preserved, should be available for study and an explanation given on how decay and discoloration organisms enter and move throughout the living tree.
  2. Make field dissections of trees with a chain saw to show visible signs and symptoms of decay. Study and trace how decay organisms move throughout the tree.

V. Study of Important Rust, Stem, Foliage, and Root Diseases
- A. Units of Instruction
  1. Study and identification of important forest tree diseases
  2. Suggested list of Northeastern disease problems
     a. Etiology of ash and maple decline
     b. Beech bark disease—*Nectria coccinea,* var. *Faginata*

- c. Strumella canker—*Strumella coryneoidea*
- d. Nectria canker—*Nectria galligena*
- e. Root rots of seedlings—*Phytophthora*
- f. Oak wilt—*Chalara quercina*
- g. Nematodes
- h. Anthracnoses—*Gnomonia* and *Glomerella*
- i. Rhabdocline needle cast—*Rhabdocline pseudotsugae*
- j. White pine blister rust—*Cronartium ribicola*

B. Laboratory Projects
- 1. Have a representative from the State or Federal plant pest division give a presentation on the State's organization and operational procedures used to combat major tree disease problems.
- 2. Make a field trip to study disease plots established by a forestry organization.

VI. Introduction to Insects

Units of Instruction
- 1. Damage caused by insects
  - a. Direct
  - b. Indirect
- 2. Evaluation of the damage caused by insects
- 3. History of control measures
- 4. Insects in general
  - a. Beneficial aspects
  - b. When an insect becomes a pest

VII. Classification, Structure, and Development of Insects

A. Units of Instruction
- 1. Classification
  - a. Phylum
  - b. Class
  - c. Orders
    - (1) *Coleoptera*
    - (2) *Lepidoptera*
    - (3) *Hymenoptera*
    - (4) *Hemiptera*
    - (5) *Isoptera*
- 2. Structure
  - a. Body wall
  - b. Head
  - c. Thorax
  - d. Abdomen
- 3. Life Cycle
  - a. Fertilization
  - b. Egg
  - c. Pupa
  - d. Larva
  - e. Adult

B. Laboratory Project

Dissect a live or preserved typical insect to study its external structure for future field identification. A knife, hand lens, and large hat pin are the only equipment needed. Dissection may be done either in a typical classroom or in a laboratory.

VIII. Forest Insect Damage

A. Units of Instruction
- 1. Leaf-eating insects
- 2. Innerbark boring insects
- 3. Woodboring insects
- 4. Sapsucking insect
- 5. Tip feeding insects
- 6. Root feeding insects
- 7. Cone and seed destroying insects

B. Laboratory Projects
- 1. Provide a slide-lecture talk by a forest entomologist on the more important forest insect pests and the damage caused by them.
- 2. Conduct an indoor laboratory using examples of typical damage caused by forest insects.
- 3. Show and discuss films on how major insect epidemics occurred and were controlled by public and private agencies.

IX. Insect Control Measures

A. Units of Instruction
- 1. Direct control
  - a. Mechanical
  - b. Biotic
  - c. Chemical
- 2. Indirect Control
  - a. Biotic
  - b. Silvicultural practices
  - c. Chemical
  - d. Statutory regulations

B. Laboratory Projects
- 1. Make a field trip to a State, Federal, or educational research station and survey plots for explanation of the nature of control, evaluation, and

experimental work being conducted.

2. Make a field trip to a laboratory where pesticides are being tested or formulated for control of insect pests.
3. Have a cooperative extension representative discuss his role in educating and assisting the public in the correct application and care of pesticides.
4. Have a representative from a noted shade tree company explain its procedures for protecting ornamental and shade trees from insects and diseases. This should include the correct methods in using and storing pesticides.

X. Regional Survey of Forest Insect Pests of Economic Importance

A. Units of Instruction
   1. Conifer defoliators
   2. Hardwood defoliators
   3. Tip feeders
   4. Sap feeders
   5. Cambium feeders
   6. Flat head wood borers
   7. Round head wood borers
   8. Ambrosia beetles
   9. Termites
   10. Carpenter ants
   11. White grubs
   12. Seed destroyers

B. Laboratory Projects
   1. Conduct a field exercise to locate, capture, and identify forest insect pests. Nature and extent of damage they inflict should be noted and studied.
   2. Have a representative of a public or private agency present an indoor laboratory exercise on the methods and procedures used to observe and combat major forest insect pests.

XI. Introduction to Fire Protection and Control

Units of Instruction
1. Prevention
2. Presuppression
3. Suppression
4. Economic factors
5. Relationship to insects and diseases
6. Use of fire as a silvicultural tool (prescribed burning)

XII. Fire Prevention Planning

A. Units of Instruction
   1. Problems of fire danger rating
      a. Fire danger rating system
      b. Burning index
      c. Build-up index
   2. Fire control planning
      a. Rate of spread
      b. Resistance to control

B. Laboratory Projects
   1. Conduct a practical exercise on using the fire danger rating system.
   2. Conduct a field problem developing a fire plan for a forest area. The three basic factors of fuel, weather, and topography should be considered. The area should be studied to determine the rate of spread a potential fire will have and the resistance to control it will offer.

XIII. Fire Behavior and Effects

A. Units of Instruction
   1. Principles of combustion
   2. Forest fuels
   3. Weather
   4. Topography
   5. Effects on vegetation and soil

B. Laboratory Projects
   1. Show and discuss the U.S.D.A. Forest Service fire training films, "Introduction to Fire Behavior" and "Fire in the Forest."
   2. Conduct a field exercise demonstrating the effects fuel, weather, and topography have on an actual fire. This should be a well organized and supervised exercise in order to keep the fire under control.
   3. Set up a weather station, take readings, and compute the fire danger index.

XIV. Fire Prevention and Presuppression Measures

A. Units of Instruction
   1. Reduction of risk
      a. Major causes of fires
      b. Frequency of occurrences
      c. When and where fires are started
      d. Why fires occur

2. Prevention methods
   a. Understanding, reaching, and influencing people
   b. National Cooperative Forest Fire Prevention Campaign
   c. Keep Green Program
3. Reduction of hazard
   a. Fire breaks
   b. Area fuel reduction
4. Presuppression planning and organization
   a. Hour control
   b. Hazard mapping
   c. Crew plan
   d. Communications

B. Laboratory Projects
1. Have a U.S.D.A. Forest Service fire control officer present the Forest Service's fire protection methods.
2. Have a State fire control supervisor present the State's fire protection methods.

XV. Suppression Measures

A. Units of Instruction
1. Methods and tactics of control
   a. Direct control
   b. Indirect control
2. Line crew organization
3. Building the fire line
   a. One lick method
   b. Progressive method
   c. Rotary method
4. Use of hand tools and equipment
5. Use of water
   a. Back pack pumps
   b. Power pumps
   c. Gravity systems
   d. Aerial tankers

B. Laboratory Projects
1. Provide practical training in building fire lines, using the different methods and hand tools.
2. Induce a State or Federal fire training officer to instruct and conduct practical training on building fire lines.
3. Use and discuss U.S.D.A. Forest Service fire training films:
   a. "Building the Fire Line"
   b. "Crew Boss"
   c. "Fire Plow Performance and Use"
   d. "Water on the Fire"
   e. "Air Tanker Attack"
   f. "Fire vs. Fire"
4. Conduct a simulated fire suppression problem implementing a fire plan. A situation is stipulated in which the weather and the availability of manpower, tools, supplies, and equipment are given.

Texts and References

ANDERSON. *Forest and Shade Tree Entomology.*

BOYCE. *Forest Pathology.*

CRAIGHEAD. *Insect Enemies of Eastern Forests.*

DAVIS. *Forest Fire: Control and Use.*

GRAHAM and KNIGHT. *Principles of Forest Entomology.*

MARSH and BROWER. *Insect Primer.*

SHENEFELT and BENJAMIN. *Insects of Wisconsin Forests.*

SILVERBORG. *Northern Hardwoods Cull Manual.*

SILVERBORG. *Tree Diseases in New York State Plantations.*

STEVENS. *Disease in Plants.*

U.S.D.A. *Forest Fire Fighting Fundamentals.*

U.S.D.A. *Insect Manual (4-H Club).*

U.S.D.A. *Plant Diseases: The Yearbook of Agriculture.*

U.S.D.A. FOREST SERVICE. *Forest Insect Conditions in the United States—1962.*

U.S.D.A. FOREST SERVICE. *Manual for Forest Fire Control.*

U.S.D.A. FOREST SERVICE. *Tree Diseases of Eastern Forests and Farm Woodlands.*

Visual Aids

Rarig's Inc., 2100 North 45th Street, Seattle, Wash. 98103.

The Enemy Is Fire. 25 minutes, 16 mm., color, sound.

U.S. Department of Agriculture, Motion Picture Service, Washington, D.C. 20250.

Air Tanker Attack. 20 minutes, 16 mm., color, sound.

Battle of the Beetles. 15 minutes, 16 mm., black and white.

Building the Fire Line. 27 minutes, 16 mm., color, sound.

Crew Boss. 35 minutes, 16 mm., color, sound.

Eastern White Pine. 19 minutes, 16 mm., color, sound.

Fire in the Forest. 22 minutes, 16 mm., color, sound.

Fire Plow Performance and Use. 14½ minutes, 16 mm., color, sound.

Fire vs. Fire. 20 minutes, 16 mm., color, sound.

Water on the Fire. 27 minutes, 16 mm., color, sound.

ADVANCED FOREST MEASUREMENTS

Hours Required

Class, 2; Laboratory and/or Field, 8.

Course Description

This course is an extension of Elementary Forest Measurements, requiring the student to build upon and put into practice the principles and skills previously learned about forest inventory, which is to describe the quantity, type, and quality of forest trees as well as the land characteristics upon which the stand grows. A technician must be skilled and knowledgeable in the techniques of management of forest areas based on gathering and utilizing information on volumes, growth rates, stand conditions, location of stands, and topography in terms of economical harvesting operations. Emphasis in this course is placed on the statistical determination of cruising accuracy, forest inventory techniques, construction and use of local volume tables, and forest type mapping.

It is necessary that sufficient land area of various timber types and topography be available for cruising.

Major Divisions

	Hours Class	Laboratory and/or field
I. Introduction to Forest Inventory	2	4
II. Basic Statistical Methods	5	12
III. Volume Table Use and Construction	6	16
IV. Type Mapping	7	20
V. Timber Inventory	12	76
Total	32	128

I. Introduction to Forest Inventory
  A. Units of Instruction
    1. Reasons for inventories
    2. Uses of inventory methods
    3. Types of inventory measurements
  B. Laboratory Projects
    1. Demonstrate to the students the use of various timber inventory tools in the field.
    2. Review the use of instruments previously learned in Elementary Forest Measurements.
    3. Require a report discussing forest inventory uses and requirements. The report should emphasize the use of the proper tools and techniques for the economic objectives of the inventory.

II. Basic Statistical Methods
  A. Units of Instruction
    1. Accuracy of measurement
    2. Population and samples
      a. Finite
      b. Infinite
      c. Sampling
      d. Stratification
    3. Frequency distribution
      a. Normal
      b. Skewed
    4. Measures of central tendency
      a. Mean—weighted and arithmetic
      b. Mode
      c. Median
    5. Measures of dispersion
      a. Range
      b. Standard deviation
      c. Standard error
        (1) Number of observations required for a given degree of accuracy
        (2) Normal curve and distribution
  B. Laboratory Projects
    1. Give practical demonstrations to the students in indoor laboratory periods in the use of statistics in designing a cruise.
    2. Give the students selected *practical* problems in statistical computations.
    3. Take a field trip to a company or firm which has a computer and explain to the students how computers are operated and how they are utilized in forest management operations.

- III. Volume Table Use and Construction
  - A. Units of Instruction
    - 1. Problems with volume tables
      - a. Standard
      - b. Local
    - 2. Gathering and developing data for volume table construction
      - a. Standard volume table construction
      - b. Local volume table construction
        - (1) Trial curves
        - (2) Balanced curves
      - c. Cumulative volume table construction and use
      - d. Form class volume table construction and use
  - B. Laboratory Projects
    - 1. Have students gather local volume table data and assemble it into useable form, using at least three local commercial species groups.
    - 2. In an indoor laboratory, have students construct local volume tables for species studied; volumes will be curved and adjusted for later use. Require a report of each student on the creation of local volume tables and their use in comparison to standard volume tables.

- IV. Type Mapping
  - A. Units of Instruction
    - 1. Recognizing forest types
      - a. Ground observations
      - b. Photo interpretive observations with single photos and stereopairs
    - 2. Reasons for stratification
      - a. Utilization—markets—stumpage value
      - b. Quantities per acre
      - c. Heights based on d.b.h. differences
      - d. Area by volume and type
    - 3. Site quality affecting types
    - 4. Cover types
      - a. Composition
      - b. Age
      - c. Density
    - 5. Volume and density corrections
    - 6. Varying the percentage covered by strips or lines in different cover types
    - 7. Mapping of stand types
      - a. Stock and stand tables
      - b. Acreage calculations
  - B. Laboratory Projects
    - 1. Make an on-site inspection of a forest area and observe the type differences by species and age; evaluate these differences due to site differences.
    - 2. Run a series of short cruise lines through a forest stand and allow the students to classify it by the stratification of species and ages.
    - 3. Break the group into crews of two or three men and assign them an area of forest land. Have them make a boundary survey of the area by staff compass and tape, and then draft the map in preparation for later use.
    - 4. Require the students to use aerial photos of their area to determine and observe the bounds and timber types.
    - 5. Using aerial photos, locate a crew's position in a forest and the direction and distance required to emerge. The location should be away from travelled roads.

- V. Timber Inventory
  - A. Units of Instruction
    - 1. History and present status
    - 2. Factors influencing timber estimates
      - a. Purpose
      - b. Size of area
      - c. Time allocation
      - d. Cost estimates
      - e. Timber value
      - f. Topography
    - 3. Method of data tabulation and presentation
      - a. Field tally sheets
      - b. Punch card data and mark sense cards
    - 4. Sources and limits of error in timber estimating
    - 5. Total estimates
      - a. Where and when utilized
      - b. Method of operation
    - 6. Sampling procedures
      - a. Size and shape of sampling unit
      - b. Systematic sampling
      - c. Random sampling
      - d. Stratified random sampling
      - e. Intensity of sampling
      - f. Design of a cruise to fit a price
      - g. Punch card and mark sense tables

7. Cruise techniques and operations
    a. Strip cruises
        (1) Number of strips and spacing to fit statistical requirements
        (2) Method of operations
        (3) Errors in strip cruising
        (4) Orientation with aerial photos
    b. Plot and line plot techniques
        (1) Cruise line spacing, plot size, and number
        (2) Method of operations
        (3) Errors involved
        (4) Orientation with aerial photos
    c. Bitterlich (point sampling) method
        (1) Line and variable plot method
        (2) Random plot method
        (3) Volume computations
        (4) Errors involved
        (5) Orientation with aerial photos
8. Continuous forest inventory
    a. Reasons and history
    b. Requirements of data gathering
    c. Photo orientation and stratification
    d. Method of presentation
9. Cruise reports
    a. Significance
    b. Requirements
        (1) Volume
        (2) Types
        (3) Quality
        (4) Topography
        (5) Mapping
        (6) Written and tabular presentation

B. Laboratory Projects
1. Assign crews of two or three men to an area and, using the boundary control maps constructed in the previous exercise and aerial photos, have the students design and execute a strip cruise of the area. Require a cruise report of each student containing all the available information gathered in the field.
2. Assign crews of two or three men to a sizeable tract and have them design and execute a line plot cruise, using aerial photos for plotting and control. Submit a complete cruise report of the area covered.
3. Explain the use of prisms under field conditions and allow the students to calibrate their prisms.
4. Using local volume tables derived in a previous laboratory exercise, have the students construct volume-basal area ratio tables.
5. Assign crews of two or three men to the same block they cruised under item 2. Have the students design and execute a line-variable plot cruise on this area and submit a complete report of this cruise with comparisons as to time, accuracy, and other factors with the more conventional line-plot system completed under 2 above.

Texts and References

Avery. *Forest Measurements.*

Avery *and* **Herrick.** *Field Projects and Classroom Exercises in Basic Forest Measurements.*

Bruce. *Prism Cruising in the Western United States and Volume Tables for Use Therewith.*

Dilworth. *Log Scaling and Timber Cruising.*

Dilworth *and* **Bell.** *Variable Plot Cruising.*

Freese. *A Guidebook for Statistical Transients.*

Fryer. *Elements of Statistics.*

Hedlund *and* **Christopher.** *Southern Forest Survey Field Instructions.*

Hovind *and* **Rieck.** *Basal Area and Point Sampling.*

Huntsberger. *Elements of Statistical Inference.*

Husch. *Forest Mensuration and Statistics.*

Kulow. *Elementary Point Sampling.*

Shain *and* **Rudolph.** *Continuous Forest Inventory.*

Spurr. *Forest Inventory.*

Visual Aids

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

Angles in Timber Cruising. Slide-tape program. 176 slides.

FOREST PHOTO-INTERPRETATION

Hours Required

Class, 1; Laboratory and/or Field, 6.

Course Description

This course is an introductory study of the basic techniques of aerial photo-interpretation. No attempt is made to cover complex subjects such as topographic mapping or the operation of expensive stereo-plotting instruments. Proficiency in photo-techniques can only be developed by directed practice over an extended period of time. The student is introduced to the arrangement of aerial photos for stereoscopic viewing, determination of scale, ground distance, acreage, bearings, object heights, and timber volumes and timber types.

It is desirable that this course consist of 1 hour of lecture followed by a 3-hour laboratory session, preferably at the beginning of the week, with another 3-hour laboratory later in the week. The student should have completed course work in Surveying, Drawing, and Measurements prior to enrolling.

Laboratory exercises using aerial photographs of the local area should include problems in photo scale, relief displacement, height, bearings, distances, and type mapping. This program is closely tied in to the work given in Advanced Forest Measurements.

The instructor should have readily available three aerial photos per student with forward overlap of 60 percent made with a precision aerial camera with a focal length of 8¼". U.S. Agriculture Department 9" x 9" photos of a local area at a scale of 1:15840 are adequate. If photographs are obtainable from Federal or private agencies, a photogrammetry laboratory kit may be used.

The instructor should have a number of stereograms showing various landforms and man-made structures for identification purposes in studying cover types.

The instructor should stress the use of photos and allow ample time for the practical use of photos as maps and for locating property lines, timber typing, and preliminary road location.

Major Divisions

	Hours Class	Laboratory and/or field
I. Development and Application of Aerial Photography	1	6
II. Aerial Photo Specifications and Stereoscopy	2	12
III. Seasonal Effects on Photography—Films and Filters	1	6
IV. Forest Cover Types—Identification and Keys	2	12
V. Photographic Scale and Horizontal Measurements	2	12
VI. Displacement on Single Aerial Photographs	1	6
VII. Displacement on Stereopairs	2	12
VIII. Area Determination	1	6
IX. Mapping and Road Location	2	12
X. Forest Inventory	2	12
Total	16	96

I. Development and Application of Aerial Photography
  A. Units of Instruction
    1. Development of aerial photography and photogrammetry
      a. Daguerreotype
      b. Mapping
      c. Eastman film
      d. Wright Brothers flight
      e. World War I and II
    2. Application of aerial photographs
      a. Topographic and planimetric maps
      b. Uses in forestry

      1. Mapping
      2. Inventory
      3. Administration
      4. Geology
      5. Land use changes
  B. Laboratory Projects
    1. Discuss and demonstrate film components.
    2. Have students conduct a standard stereoperception test.
    3. Map reading
      a. Orientation by topographic maps
      b. Information on topographic maps
    4. Using a topographic map:
      a. Determine true and magnetic meridians.
      b. Plot magnetic bearing using declination.
      c. Determine height of a ridge using contour lines.
      d. Determine ground distance between two points and compare results to bar scale.

II. Aerial Photo Specifications and Stereoscopy
  A. Units of Instruction
    1. Angle of photography
    2. Cameras
      a. Lenses and mounting
      b. Multiple camera photography
    3. Special purpose photography
    4. Method of flying
      a. Overlap
      b. Crab
      c. Tilt
      d. Time of day
      e. Weather
    5. Photographic prints
      a. Photo index system
      b. Available weights and types of photos
      c. Advantages and disadvantages of each
      d. Sources and procedures for obtaining required photos
    6. Information on prints
    7. Marking prints
    8. Stereoscopy
      a. Monocular
      b. Binocular
      c. Stereoscopic
    9. Types of stereoscopes
    10. Orientation of photos for stereoscopic study
  B. Laboratory Projects
    1. Study orientation of stereopairs—locate and mark principle and conjugate principle points.
    2. Discuss and demonstrate information on prints: how to mark, store, and file.
    3. Determine photo base lines and lengths.
    4. Plot true meridians on stereopairs.
    5. Demonstrate various types of stereoscopic devices.
    6. Demonstrate pseudoscopic images.

III. Seasonal Effects on Photography—Films and Filters
  A. Units of Instruction
    1. Climatic cycles
    2. Interpretation needs varied by season
    3. Types of emulsions—spectrum discussion
  B. Laboratory Projects
    1. Discuss and demonstrate various film and filter combinations with seasonal vegetation changes.
    2. Make a field trip to an agency handling varied film and filter types and discuss their uses. Practice stereoscopic viewing of prints from film and filter combinations.

IV. Forest Cover Types—Identification and Keys
  A. Units of Instruction
    1. Object recognition through shape and dimension
    2. Tone—variability
    3. Texture—variability due to object
    4. Shadows—influence on texture—errors due to shadows
    5. Human factor in photo-interpretation
      a. Visual acuity
      b. Mental acuity
    6. Equipment factors in photo-interpretation
  B. Laboratory Projects
    1. Demonstrate and explain identification of forest cover types using photographs.
    2. Identify objects on photos using elimination keys.

3. Make a field tour with photos and pocket stereoscopes to coordinate aerial photo objects with actual ground observed objects.
4. Assign individual student problems in timber typing and cultural features.

V. Photographic Scale and Horizontal Measurements
  A. Units of Instruction
    1. Determination of photo scale
    2. Variation in scale
      a. Focal length
      b. Flying height
      c. Tilt
    3. Geometry of scale
    4. Selection of scale
    5. Determination of flying height when focal length is known
    6. Determination of horizontal measurements on vertical photographs with ground checks
  B. Laboratory Projects
    1. Solve a field problem for finding the scale of a photograph without resorting to topographic maps.
    2. Make an "office" calculation of scale using 1:24000 or 1:62500 scale topographic maps.
    3. Demonstrate the use of scale transfer tables.
    4. Calculate the flying height required to take photographs for use in differential parallax measurements.
    5. Determine the ground distance between two points by computing photo scale reciprocal.
    6. Assign problems in photo scale calculations.
    7. Plan a problem for the determination of bearings by establishing a true bearing meridian on the photos. Using a protractor and engineer's scale, determine the true or magnetic bearings and distances from various points of origin to objectives.

VI. Displacement on Single Aerial Photographs
  A. Units of Instruction
    1. Sources of displacement on vertical photographs
    2. Displacement due to photographic equipment
    3. Displacement due to topography
    4. Determination of height from topographic displacement
    5. Effects on displacement due to relief and tilt
    6. Shadow length measurements on single photos
    7. Determination of height from topographic displacement on single photos
    8. Student problems in displacement
  B. Laboratory Project
    Determine the heights of various objects on single photos by shadow length and topographic displacement using the engineer's scale.

VII. Displacement on Stereopairs
  A. Units of Instruction
    1. Absolute stereoscopic parallax
    2. Micrometer floating–mark devices and principles
    3. Variations in elevation of two principal points in a stereopair
    4. Determining elevation by parallax wedge and Abrams height finder
    5. Accuracy of height measurements of stereoscopic parallax
    6. Measurement of slope percent on aerial photos
  B. Laboratory Projects
    1. Carefully measure differential parallax with an engineer's scale between two points. Then determine the difference in elevation of these two points by the parallax formula after first computing the photo base length and photo scale.
    2. Compute the heights of various photo objects by stereometer or Abrams height finder using the differential parallax formula. Check these heights by ground measurements for a comparison of results.

VIII. Area Determination
  A. Units of Instruction
    1. Effect of variations in scale on area
      a. Relief
      b. Tilt
      c. Slope
    2. Accuracy of measurements

        3. Methods of area measurements
            a. Planimeters
            b. Transects
            c. Dot grid
    B. Laboratory Project

    Make acreage determinations using the planimeters, transects, and dot grid methods on selected areas on their stereopairs. This will necessitate the student's use of scale and proportional theory.

IX. Mapping and Road Location
    A. Units of Instruction
        1. Rectangular coordinate systems
        2. Ground control
        3. Type maps
        4. Uncontrolled maps
        5. Controlled maps
        6. General Land Office plats
        7. Importance of short access roads in forest management
        8. Preliminary lines
        9. Deductions as to:
            a. Soil
            b. Rock
            c. Slope
            d. Timber extraction
        10. Costs of aerial vs. ground techniques
    B. Laboratory Project

    Determine the parallax difference in 0.001 inch for a specific percent slope after computing the parallax factor at various points on your forest access road, using student stereopairs. Determine elevations at point A and point B and determine air line distance. Lay out a preliminary road location on the photo and record. Move up or down slope as required to meet specifications. Show the final location in red pencil or ink.

X. Forest Inventory
    A. Units of Instruction
        1. Future of forest inventory in management
            a. Mapping for ground control
            b. Individual measurement of trees and stands
        2. Limitations
            a. Stem diameter
            b. Cull factor
            c. Growth
            d. Identification of species
        3. Coordination of ground and aerial methods of inventory
        4. Stand measurements vs. individual measurements
        5. Crown closure percent as reflected in stocking
            a. Shadows
            b. Small holes
        6. Adjusting photo volume by field checks
        7. Reliability of photo volumes
    B. Laboratory Projects
        1. Make studies of volume of individual trees:
            a. Collect data on five to ten dominant and co-dominant trees 6.0 inches in diameter and larger. Data should consist of stem diameters, crown diameters, merchantable heights, and total heights. Span a wide range of diameters and heights. Obtain these measurements in readily identifiable trees in an open area, preferably areas readily seen on the photos.
            b. Obtain crown diameter to the nearest foot possible using photos and crown diameter scales. Obtain heights of these trees using parallax or shadow length.
            c. Compute volumes by local cubic foot aerial volume tables and compare with field volumes.
        2. Study volume of forest stands as follows:
            a. Locate ½-acre plots on photos.
            b. Determine average total tree heights, average crown diameter, and percent of crown closure. Using these values, obtain gross cubic volumes from a local aerial volume table.
            c. Precisely locate each plot on the ground and obtain field volumes.
            d. Construct a regression line by plotting field volumes over corresponding photo volumes and adjust each plot volume.

Texts and References

AVERY. *Foresters Guide to Aerial Photo-Interpretation.*

AVERY. *Interpretation of Aerial Photographs.*

BAKER. *Elements of Photogrammetry.*

MOESSNER. *Basic Techniques in Forest Photo-Interpretation.*

SPURR. *Photogrammetry and Photo-Interpretation.*

Visual Aids

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.

Basic Photo-Interpretation. **Slide-tape program. 700 slides.**

REGIONAL FOREST PRACTICES AND UTILIZATION

Hours Required

Class, 0; Field, 120.

Course Description

A 3-week field tour to study regional forest practices and utilization. A major objective of this course is to extend the student's knowledge acquired in each major area of forest technology during his 2 years of formal course work by exposing him to a variety of field observations and different resource personnel. The tour should cover such major areas of forestry as: the Federal and State approach to forest management; the techniques and methods of forestry as practiced by private consulting foresters; industrial foresters' approaches to forest management; recreation, wildlife, and multiple-use management as practiced by the various agencies; forest research studies being conducted by experimental foresters; tree nursery operations; Federal, State, and municipal watershed management; and harvesting methods, machinery and equipment.

A further objective is to introduce and contrast primary and secondary wood utilization. This is an expansion or continuation of the Forest Products Utilization course. Industries may be observed which are too distant from the educational institution to be visited during the regularly scheduled course. Industries such as paper companies, veneer and plywood plants, furniture manufacturing firms, and other specialty industries such as bobbin factories, dowell plants, and dimension square plants are visited. If possible, two industries manufacturing identical products such as pallets, boxes, and crates or turnings should be visited and contrasted with one another to give the student two different viewpoints on how management produces the product. One firm might have been studied in the Utilization course and the other visited during the tour.

Major subject divisions of the 3-week tour are not listed as in other course syllabi. An example of a typical schedule is presented as a substitute. Texts, references, and handouts are assigned for the particular subject matter being covered. Additional handouts are distributed when required *prior* to making the visit. More benefit will be derived at each stop and from each resource person if the student is prepared for what he will see and what will be discussed at each location on the tour. This will give him a better understanding and a better basis for interpreting what is being seen.

Major Divisions

The scheduled tour. See example of a typical schedule for a 3-week itinerary.

Texts and References

ALLISON *and* LEIGHTON. *Evaluating Forest Campground Sites.*

BARRETT. *Regional Silviculture of the United States.*

BOYCE. *Forest Pathology.*

BROWN *and* BETHEL. *Lumber.*

BURT *and* GROSSENHEIDER. *A Field Guide to the Mammals.*

COBB. *Skidding With Rubber-Tired Tractors in the Tennessee Valley.*

CRAIGHEAD. *Insect Enemies of Eastern Forests.*

DILWORTH. *Log Scaling and Timber Cruising.*

FORBES. *Forestry Handbook.*

GRAHAM *and* KNIGHT. *Principles of Forest Entomology.*

HAMLIN *and others.* "The Pulp Chipping Program in the Northeast."

JILES. *Hardwood Logging Methods and Costs in the Tennessee Valley.*

KELLEY *and* LAWYER. *How To Organize and Operate a Small Business.*

LEWIS. "Wood Residue Utilization."

MCCRAW. "Relative Skidding Production of Track and Wheel Skidders."

NATIONAL HARDWOOD LUMBER ASSOCIATION. *An Introduction to the Grading and Measurement of Hardwood Lumber.*

PANSHIN *and others. Forest Products.*

SIMMONS. *Northeastern Logger's Handbook.*

U.S.D.A. FOREST SERVICE. *A Guide to Hardwood Log Grading.*

REGIONAL FOREST PRACTICES (Example of a 3-Week Tour Itinerary)

Day and Date	*Name of Agency*[1]	*Subject*[2]	*Location*
Monday, May 9	Massabesic Experimental Forest, USFS	White Pine Silviculture	Alfred, Maine
Tuesday, May 10	Bear Brook State Park (a.m.) Bear Brook State Park (p.m.)	State Recreation State Forest Management	Allenstown, N.H. Allenstown, N.H.
Tuesday evening, May 10		Instructors' and Students' Discussion, 7:00–9:00 p.m.	Classroom
Wednesday, May 11	Manchester Waterworks (a.m.)	Municipal Watershed Management	Auburn, N.H.
	Caron Box & Lumber Co. (p.m.)	Boxboard Manufacture	Manchester, N.H.
Thursday, May 12	State Forest Nursery (a.m.) Kear-Wood, Inc. (p.m.)	Nursery Operations Consulting Forestry	Gerrish, N.H. Wilmot, N.H.
Thursday evening	Overnight Stop—Plymouth State Teachers' College		Plymouth, N.H.
Friday, May 13	Russell Pond Campground USFS (a.m.) Woodsville Chipping Plant (p.m.)	Federal Recreation Centralized Chipping	North Woodstock, N.H Woodsville, N.H.
Friday evening, May 13, to Monday morning, May 23			Headquarters Colebrook, N.H.
Saturday, May 14	Groveton Paper Company	Papermaking	Groveton, N.H.
Sunday, May 15	Layover		Colebrook, N.H.
Monday, May 16	Washburn's Sawmill (a.m.) Plywood Products (p.m.)	Hardwood Band Mill Hardwood Plywood	North Stratford, N.H. North Stratford, N.H.
Monday evening, May 16		Instructors' and Students' Discussion, 6:00–8:00 p.m.	Headquarters
Tuesday, May 17	Beechers Falls Furniture Manufacturing	Furniture Making	Beechers Falls, Vermont
Tuesday evening, May 17	Vermont Department of Forests and Parks	State Recreation	Headquarters
Wednesday, May 18	St. Regis Paper Company	Timber Inventory and Recreation	West Stewartstown, N.H.

Thursday, May 19	St. Regis Paper Company	Harvesting and Wildlife Management	West Stewartstown, N.H.
Friday, May 20	Cree's Christmas Tree Farm	Christmas Tree Production	Colebrook, N.H.
Saturday, May 21	EXAMINATION 8:00–10:00 a.m.	Covers material presented in the first 2 weeks	
Sunday, May 22	Layover		Colebrook, N.H.
Monday, May 23	Brown Company	Harvesting Operations	Seven Islands, N.H.
Monday evening, May 23	Dolly Copp Campground, USFS	Overnight Stop Instructors' and Students' Discussion and Review of Exam	Gorham, N.H. Headquarters
Tuesday, May 24	Dolly Copp Campground, USFS (a.m.) Eastern Slopes Campground (p.m.)	Federal Recreation Private Recreation	Gorham, N.H. Conway, N.H.
Tuesday evening, May 24 to Friday morning, May 27	Eastern Slopes Campground		Headquarters Conway, N.H.
Wednesday, May 25	Bartlett Experimental Forest, USFS	Hardwood Silviculture	Bartlett, N.H.
Wednesday evening, May 25		Instructors' and Students' Discussion, 6:00–8:00 p.m.	Headquarters
Thursday, May 26	Diamond International Logging and Milling Corporation		Fryeburg, Maine
Friday, May 27	Saco Ranger District	Timber Inventory and Timber Sales	Conway, N.H.
Friday afternoon, May 27	Return to University of New Hampshire, Durham, N.H.		

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[1] Each student will be required to give a formal report on what was observed and discussed at one of the agencies visited.

[2] Assignments from text, *Forest Products* (or similar source), handouts as required, and material presented in formal courses.

Mathematics and Science Courses

TECHNICAL MATHEMATICS
(Algebra and Trigonometry)

Hours Required

Class, 4; Laboratory, 0.

Course Description

Technical Mathematics is designed to provide the student with the necessary mathematics to understand and work with the principles covered in the technical courses. Care has been taken to develop the various topics in mathematics before the student is required to use the mathematical tools and methods in the concurrent technical courses.

As the various topics are introduced, the meaning and underlying principles of each and the role each plays in forest technology should be considered before the subject itself is explored. Practical problems following the exposition of each major topic will help motivate the student and will strengthen his understanding of the principles involved.

Note: Use of the slide rule is not taught in this course since it is the consensus of industrial personnel that facility with the slide rule is not necessary, although it may be desirable. The use of the desk calculator, however, is introduced early in the course to provide the student with skill in its use as a tool in solving mathematical problems without delaying his progress in learning fundamental mathematical principles necessary to understand forest measurements.

Major Divisions

	Class Hours
I. Fundamental Concepts and Operations	9
II. Functions and Graphs	7
III. Trigonometric Functions	6
IV. Linear Equations and Determinates	6
V. Factoring and Fractions	6
VI. Quadratic Equations	5
VII. Trigonometric Functions of Any Angle or Number	7
VIII. Exponents and Radicals	5
IX. Logarithms	5
X. Properties of the Trigonometric Functions	8
Total	64

I. Fundamental Concepts and Operations

Units of Instruction

1. Numbers and literal symbols
2. Fundamental laws of algebra
3. The law of signs
4. Operations with zero
5. Exponents and radicals
6. Additions and subtractions of algebraic expressions
7. Multiplication and division of algebraic expressions
8. Equations and formulas
9. Problems
10. Questions
11. Examination

II. Functions and Graphs

Units of Instruction

1. Functions
2. Cartesian coordinates
3. Graphing functions
4. Zeros of a function
5. Problems
6. Questions
7. Examination

III. Trigonometric Functions

Units of Instruction

1. Angles
2. The right triangle
3. The trigonometric functions
4. Values of the trigonometric functions
5. Use of tables
6. Problems
7. Questions
8. Examination

IV. Linear Equations and Determinates
Units of Instruction
1. Linear equations
2. Graphical solution of systems of two linear equations with two unknowns
3. Algebraic solution of systems of two linear equations with two unknowns
4. Solution by determinates of systems of two linear equations with two unknowns
5. Algebraic solution of three linear equations with three unknowns
6. Solution by determinates of systems of three linear equations with three unknowns
7. Problems
8. Questions
9. Examination

V. Factoring and Fractions
Units of Instruction
1. Special products
2. Factoring
3. Simplifying fractions
4. Multiplication and division of fractions
5. Addition and subtraction of fractions
6. Problems
7. Questions
8. Examination

VI. Quadratic Equations
Units of Instruction
1. Solution of quadratic equations by factoring
2. Completing the square
3. The quadratic formula
4. Problems
5. Questions
6. Examination

VII. Trigonometric Functions of Any Angle or Number
Units of Instruction
1. Signs of the trigonometric function
2. Radian
3. Applications of the use of radian measure
4. Trigonometric functions of any angle
5. Problems
6. Questions
7. Examination

VIII. Exponents and Radicals
Units of Instruction
1. Positive integers as exponents
2. Zero and negative integers as exponents
3. Fractional exponents
4. Simplest radical form
5. Addition and subtraction of radicals
6. Multiplication and division of radicals
7. Problems
8. Questions
9. Examination

IX. Logarithms
Units of Instruction
1. Exponential and logarithmic functions
2. Properties of logarithms and exponents
3. Logarithms to the base 10
4. Computations using logarithms
5. Problems
6. Questions
7. Examination

X. Properties of the Trigonometric Functions
Units of Instruction
1. Fundamental trigonometric identities
2. Sine and cosine of the sum and difference of two angles
3. Double angle formulas
4. Half angle formulas
5. Trigonometric equations
6. Review of right triangles
7. Extension of functions for angles greater than ninety degrees
8. Graphs of the six functions
9. Problems
10. Questions
11. Examination

Texts and References

ADAMS. *Intermediate Algebra.*
COMBELLACK. *Introduction to Elementary Functions.*
CORRINGTON. *Applied Mathematics for Technical Students.*
HALL *and* KATTSOFF. *Unified Algebra and Trigonometry.*
JUSZLI *and* ROGERS. *Elementary Technical Mathematics.*
LENNHARDY. *College Algebra.*
ROSSWEILER *and* HARRIS. *Mathematics and Measurement.*

Visual Aids

Coronet Films, Inc., Coronet Bldg., Chicago, Ill. 60601.
Pythagorean Theorem, The Cosine Formula. 5½ minutes, 16 mm., black and white, sound.
Pythagorean Theorem, Proof by Area. 5½ minutes, 16 mm., black and white, sound.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Ill. 60604.
Axioms in Algebra. 13 minutes, 16 mm., color, sound.

BOTANY

Hours Required

Class, 2; Laboratory and/or Field, 3.

Course Description

In this elementary study of plant anatomy, physiology, reproduction, and response to stimuli, plant cell structure and metabolism are introduced and roots, stems, leaves, flowers, and seeds are studied.

Class work and laboratory work are planned and coordinated to increase the student's basic and useful working knowledge of plants and to prepare him with certain techniques needed in controlling plant growth.

The main objective of this course is to encourage a thorough understanding of plant parts, functions, reaction to certain stimuli, and reproduction. The information and experiences gained will enable the technician to more adequately perform various propagation operations, such as nursery bed seeding; scarification, stratification, budding and grafting, certain techniques of plant protection; and any work that is based on a knowledge of plant nutrition. They will provide the basic ground work for further advancement in wood technology. In order to accomplish these objectives, it is recommended that a single micro-projector, which will project slides on a screen, be used instead of individual microscopes for students for the study of cells, tissues, and other microscopic structures. The best visual aids are the actual organs or organisms which are being studied. Technician work involves actual participation. For this reason, most of the laboratory exercises should be planned so the student will study real plants and plant parts. Although provisions have been made for 3 hours of laboratory classes per week, the arrangement of the periods is optional for the instructor to permit maximum flexibility in scheduling.

The subject matter in this course should be coordinated closely with that of the course in Dendrology which is taught concurrently.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Plant Structure and Functions (Anatomy and Physiology)	10	12
II. Plant Reaction to Certain Stimuli	10	14
III. Propagation of Plants	12	22
Total	32	48

I. Plant Structure and Functions (Anatomy and Physiology)
A. Units of Instruction
1. Definitions and terminology
2. Cell structure and functions
a. Part
b. Division
(1) Mitosis
(2) Meiosis
c. Enlargement
d. Maturation and differentiation
3. Tissues and functions
a. Meristem
b. Parenchyma
c. Conductive
d. Mechanical
e. Protective
f. Callus
4. Organs and functions
a. Roots
b. Stems
c. Leaves
d. Flowers
B. Laboratory Projects
1. Study cells, callus tissue, plasmolysis.
2. Study plant organs—roots and stems.
3. Study woody stems—growth in length and diameter, importance of such tissues as phloem, xylem, cambium, callus.
4. Study plant parts—leaves and flowers.

II. Plant Reaction to Certain Stimuli
A. Units of Instruction

1. Light
   a. Intensity
   b. Quality
   c. Requirements for photosynthesis
      (1) Carbon dioxide and oxygen
      (2) Water
      (3) Light as a source of energy
      (4) Chlorophyll
   d. Light duration or photoperiod
      (1) Photoperiodism
      (2) Types of photoperiodic responses
      (3) Phytochrome
2. Plant reactions to temperature
   a. Maximum, minimum, optimum for each species
   b. Dormancy, rest periods
   c. Growth periods
3. Moisture functions and requirements
   a. Water requirements of plants
   b. A plant constituent
   c. Transpiration
   d. Absorption
   e. Water deficits
4. Carbon dioxide as a limiting factor
5. Growth substances (auxins)
   a. Flower and fruit set
   b. Fruit thinning or removal
   c. Weed control—herbicides
   d. Growth stimulants—Giberellin
   e. Growth retardants
   f. Root-inducing chemicals

B. Laboratory Projects
1. Study the light requirements of plants—quality, photoperiod, intensity, phytochrome.
2. Study the temperature requirements of plants. Make a field trip to study various exposures and plant reactions. Demonstrate the effect of temperatures on the breaking of dormancy in plant parts.
3. Study moisture requirements of plants.
4. Study nutrient requirements—optimum, deficiencies, excesses, and carbon dioxide requirements.
5. Study controlled environment growth of plants—phytotrons, greenhouses.

III. Propagation of Plants
A. Units of Instruction
1. Sexual propagation in higher plants
   a. Pollination in seed plants
   b. Formation of gametes and zygotes
   c. Seed parts and functions
   d. Seed germination
   e. Requirements for normal germination
      (1) Temperature
      (2) Moisture
      (3) Proper gases
      (4) Light in many cases
2. Asexual propagation in higher plants
   a. Reasons for propagating vegetatively
   b. Some important types
      (1) Cuttage
      (2) Layerage
      (3) Graftage
3. Propagating media
   a. Functions
   b. Desirable characteristics
   c. Examples
4. Aids to propagation
   a. Mist systems
   b. Bottom heat
   c. Polyethylene covers
5. Propagating structures
   a. Outdoors
      (1) Frames
      (2) Beds
   b. Greenhouses

B. Laboratory Projects
1. Make a field trip to a forest tree nursery. Observe land preparation, seed beds, shading, planting, storage of seeds, and young seedlings.
2. Study seed parts and functions, and seed laws.
3. Visit a seeding laboratory. Study seed protection, scarification, stratification, seeding.
4. Study propagation by cuttage and layerage.
5. Study propagation by grafting, budding, stool layering.
6. Study various synthetic auxins:
   a. Rooting various plant parts
   b. Seedless fruit
   c. Chemical thinning
   d. Growth retardants
   e. Herbicides
   f. Stimulants
7. Make a field trip to a wholesale

propagating nursery and study media, structures, propagation aids, methods.

Texts and References

Avery *and* Johnson. *Hormones and Horticulture.*
Cook. *Reproduction, Heredity and Sexuality.*
Crafts *and* Robbins. *Weed Control.*
Emerson. *Basic Botany.*
Emerson *and* Shields. *Laboratory and Field Exercises in Botany.*
Jensen. *The Plant Cell.*
King. *Weeds of the World: Biology and Control.*
Kramer *and* Kozlowski. *Physiology of Trees.*
Mahlstede *and* Haber. *Plant Propagation.*
Muller. *Botany: A Functional Approach.*
Sinnott *and* Wilson. *Botany: Principles and Problems.*
U.S.D.A. Forest Service. *Woody-Plant Seed Manual.*
Woodford *and* Evans. *Weed Control Handbook.*

Visual Aids

Churchill Films, Inc., 622 North Robertson Boulevard, Los Angeles, Calif. 90069.
Photosynthesis and Respiration Cycle. 13 minutes, 16 mm., color, sound.
Coronet Films, Coronet Building, Chicago, Ill. 60601.
How Green Plants Make and Use Food. 11 minutes, 16 mm., color, sound.
Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Ill.
The Flowering Plants. 21 minutes, 16 mm., color, sound.
Fungi. 16 minutes, 16 mm., color, sound.
Growth of Plants. 21 minutes, 16 mm., color, sound.
Gymnosperms. 17 minutes, 16 mm., color, sound.
Heredity. 11 minutes, 16 mm., black and white, sound.
Mitosis. 24 minutes, 16 mm., color, sound.
Osmosis. 14 minutes, 16 mm., black and white, sound.
Photosynthesis. 21 minutes, 16 mm., black and white, sound.
Roots of Plants. 11 minutes, 16 mm., black and white, sound.
Seed Germination. 15 minutes, 16 mm., color, sound.
McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N.Y. 10036.
Cell Reproduction (Mitosis). 28 minutes, 16 mm., color, sound.
Cell Respiration. 28 minutes, 16 mm., color, sound.
Chlorophyll. 28 minutes, 16 mm., color, sound.
Flower Structures. 28 minutes, 16 mm., color, sound.
Green Plants. 10 minutes, 16 mm., color, sound.
Leaves. 28 minutes, 16 mm., color, sound.
Life of the Angiosperm. 28 minutes, 16 mm., color, sound.
Meiosis. 30 minutes, 16 mm., black and white, sound. (Genetic Series).
Plant Reproduction. 28 minutes, 16 mm., color, sound.
The Role of Green Plants. 28 minutes, 16 mm., color, sound.
Roots. 28 minutes, 16 mm., color, sound.
Stems. 28 minutes, 16 mm., color, sound.
University of Indiana, Bloomington, Ind. 47405.
Asexual Reproduction. 10 minutes, 16 mm., color, sound.

DENDROLOGY

Hours Required

Class, 1; Laboratory and/or Field, 6.

Course Description

This basic course in the ecology and identification of the various species of woody plants typical of the major timbered regions of the United States includes a study of the habitats and principal bontanical features, forms, sites, associates, reproduction, and range of the major forest trees which are commercially important in the region of the school.

The objectives of this course are to create an interest in, a practical understanding of, and a working knowledge of the woody plants occurring in the geographical area where the course is taught. The student should be taught to identify each plant by its outstanding characteristics in as many seasons of the year as is possible, and to understand how to effectively grow these species. This requires a knowledge of the form, habit, height, soil requirements, root system, flowering and fruiting characteristics, ecological relationships, susceptibility to insect and disease attack, and peculiarities of each specie. This information will relate directly to the content of the Applied Silviculture course. An effort should me made to insure that species are observed and identified under typical and atypical forest conditions. A further effort should be made to present to the student typical tree characteristics throughout the range of seasons. The use of dichotomous plant keys should be stressed. The order of material presentation may be changed to suit the instructor and the seasons without any detrimental effects.

Laboratory exercises and studies are strongly field oriented. The subject matter of this course should be closely coordinated with that of the course in botany which is taught concurrently.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Classification of Plants	1	6
II. Plant Characteristics Used in Classification	3	12
III. Span of Life	1	20
IV. Angiosperms	2	20
V. Gymnosperms	2	20
VI. The Biotic Community (Ecosystem)	5	10
VII. Environmental Principles	2	8
Total	16	96

I. Classification of Plants
  A. Units of Instruction
    1. Need for classification
    2. Botanical classification (binomial system)
      a. Division
      b. Subdivision
      c. Class
      d. Order
      e. Family
      f. Genus
      g. Species
      h. Scientific names
  B. Laboratory Projects
    1. Visit a local herbarium or park and observe the classification of plants and their identifying characteristics.
    2. Introduce and explain the meaning of various terms in identifying characteristics of trees.

II. Plant Characteristics Used in Classification
  A. Units of Instruction
    1. Leaves
      a. General features
      b. Leaf arrangement
      c. Leaf composition
      d. Leaf shape
      e. Leaf margin
      f. Leaf apices and bases
      g. Leaf venation
      h. Surface features

2. Twigs
   a. Buds
   b. Leaf scars
   c. Stipule scars
   d. Lenticels
   e. Pith
   f. Spurs
   g. Spines and thorns
3. Bark
4. Flowering characteristics
5. Fruiting characteristics
6. Habit of growth

B. Laboratory Projects
   1. Using a dichotomous twig key, demonstrate the methodology of "keying out" a simple species which has large, well defined identifying characteristics.
   2. Allow the students to "key out" a selected group of species.

III. Span of Life
   A. Units of Instruction
      1. Annuals
      2. Biennials
      3. Perennials
         a. Herbaceous
         b. Woody
            (1) Tree
            (2) Shrub
            (3) Vine
   B. Laboratory Projects
      1. Identify ten to fifteen species of angiosperms by ecological association, taxonomy, and observation of plant characteristics under field conditions.
      2. Identify five to ten species by scientific and common name in a field quiz. These species can be softwoods, hardwoods, or a mixture depending on the instructor's preference or species in the region.

IV. Angiosperms
   General discussion of monocots and dicots —practical field identification by leaf, bark, twig, habit, site, fruit, form
   A. Units of Instruction
      1. Salicaceae
         a. *Salix*
         b. *Populus*
      2. Juglandaceae
         a. *Juglans*
         b. *Carya*
      3. Betulaceae
         a. *Betula*
         b. *Alnus*
         c. *Carpinus*
         d. *Ostrya*
         e. *Corylus*
      4. Fagaceae
         a. *Fagus*
         b. *Castanea*
         c. *Quercus*
      5. Ulmaceae
         a. *Ulmus*
         b. *Celtis*
      6. Moraceae
         a. *Morus*
      7. Magnoliaceae
         a. *Magnolia*
         b. *Liriodendron*
      8. Saxifragaceae
         a. Gooseberry and currants
      9. Hamamelidaceae
         a. *Liquidambar*
         b. *Hamamelis*
      10. Platanaceae
         a. *Platanus*
      11. Rosaceae
         a. *Prunus*
         b. *Malus*
         c. *Pyrus*
         d. *Sorbus*
         e. *Amelanchier*
         f. *Crataegus*
      12. Leguminosae
         a. *Gleditsia*
         b. *Cladrastis lutea*
         c. *Robinia*
      13. Aceraceae
         a. *Acer*
      14. Tiliaceae
         a. *Tilia*
      15. Nyssaceae
         a. *Nyssa*
      16. Oleaceae
         a. *Fraxinus*
   B. Laboratory Projects
      1. Identify ten to fifteen species of angiosperms by ecological association, taxonomy, and observation of plant characteristics under field conditions.
      2. Identify five to ten species by scientific and common name in a field

quiz. These species can be softwoods, hardwoods, or a mixture depending on the instructor's preference or available species in the region.

V. Gymnosperms

General discussion—identification by needles, bark, range, form, habit

- A. Units of Instruction
  - 1. Pinaceae
    - a. *Abies*
    - b. *Pinus*
    - c. *Larix*
    - d. *Picea*
    - e. *Pseudotsuga*
    - f. *Tsuga*
  - 2. Taxodiaceae
    - a. *Sequoia*
    - b. *Taxodium*
  - 3. Cupressaceae
    - a. *Libocedrus*
    - b. *Thuja*
    - c. *Cupressus*
    - d. *Chamaecyparis*
    - e. *Juniperus*
  - 4. Taxaceae
    - a. *Torreya*
    - b. *Taxus*
- B. Laboratory Projects
  - 1. Identify ten to fifteen species of gymnosperms by ecological association, taxonomy, and observation of plant characteristics under field conditions.
  - 2. Identify five to ten species by scientific and common name in a field quiz. These species can be softwoods, hardwoods, or a mixture depending on the instructor's preference or species in the region.

VI. The Biotic Community (Ecosystem)

- A. Units of Instruction
  - 1. Climatic factors
    - a. Radiant energy
    - b. Light—affecting the following:
      - (1) Photosynthesis
      - (2) Transpiration
      - (3) Direction of growth
      - (4) Flower production
      - (5) Enzyme action
    - c. Temperature
    - d. Air
      - (1) Carbon dioxide concentration
      - (2) Atmosphere
      - (3) Water content of atmosphere
      - (4) Wind
  - 2. Physiographic factors
    - a. Pedogenesis
    - b. Edaphology
      - (1) Mineral components and physical characteristics
      - (2) Organic content
      - (3) Soil water
        - (a) Hydrophytes
        - (b) Xerophytes
        - (c) Mesophytes
        - (d) Halophytes
      - (4) Soil atmosphere
      - (5) Chemical factors
        - (a) Soil acidity
        - (b) Exchangeable bases
        - (c) Inhibition of growth by plant products
        - (d) Alkalinity
        - (e) Salinity
      - (6) Topography
  - 3. Biological factors
    - a. Plants as factors
      - (1) Competition
      - (2) Parasites
      - (3) Epiphytes
      - (4) Symbiosis
        - (a) Mycorrhiza
        - (b) Nodules
      - (5) Other soil flora
    - b. Animals as factors
      - (1) Pollination
      - (2) Dissemination
      - (3) Soil animals
      - (4) Insects
      - (5) Large animals
      - (6) Man
- B. Laboratory Projects
  - 1. Observe, under field conditions, the effects of competition on timber stand composition. Discuss and demonstrate the relationships of edaphic and climatic factors on plant growth.
  - 2. Observe species composition in different ecological niches.

VII. Environmental Principles

- A. Units of Instruction
  - 1. Energy flow
  - 2. Cycling of minerals and gases
  - 3. Principle of limiting factors
  - 4. Plant succession

B. Laboratory Projects
  1. Conduct final examination in the identification of hardwood species under field conditions.
  2. Conduct final examination in the identification of softwood species under field conditions.

Texts and References

Billings. *Plants and the Ecosystem.*

Hardin. *Workbook for Woody Plants.*

Harlow. *Fruit Key and Twig Key to Trees and Shrubs.*

Harlow. *Trees of Eastern United States and Canada.*

Harlow and Harrar. *Textbook of Dendrology.*

Odum. *Ecology.*

Oosting. *Study of Plant Communities.*

Petrides. *A Field Guide to Trees and Shrubs.*

Visual Aids

Coronet Instructional Films, Coronet Building, Chicago, Ill. 60601.

Trees: How We Identify Them. 11 minutes, 16 mm., color or black and white, sound.

Indiana University, Audio-Visual Center, Bloomington, Ind. 47405.

How Trees Live. 16½ minutes, 16 mm., color, silent.

Succession--From Sand Dune to Forest. 16 minutes, 16 mm., color, sound.

Temperate Deciduous Forests. 16 minutes, 16 mm., color, sound.

McGraw-Hill Book Company, Text-Film Division, 330 West 42nd Street, New York, N.Y. 10036.

Applied Ecology. 28 minutes, 16 mm., color, sound.

Gymnosperms. 28 minutes, 16 mm., color, sound.

Life of the Angiosperm. 28 minutes, 16 mm., color, sound.

Likenesses and Differences in Angiosperms. 28 minutes, 16 mm., color, sound.

Plant and Animal Distribution. 28 minutes, 16 mm., color, sound.

Plant Succession. 14½ minutes, 16 mm., color, sound.

Systematics and Plant Evolution. 28 minutes, 16 mm., color, sound.

The Deciduous Forest. 28 minutes, 16 mm., color, sound.

The Spruce Bog. 28 minutes, 16 mm., color, sound.

National Film Board of Canada, 680 Fifth Avenue, Suite 819, New York, N.Y. 10019.

Native Trees of Canada. 42 frames, black and white.

Society for Visual Education, Inc., 1345 Diversey Parkway, Chicago, Ill. 60614.

Telling Trees Apart. 48 frames, color.

State University of New York, College of Forestry, Department of Forest Extension, Syracuse, N.Y. 13200.

Identifying Common Trees. 44 frames, color.

Auxiliary or Supporting Technical Courses

TECHNICAL REPORTING

Hours Required

Class, 3; Laboratory, 0.

Course Description

Technical Reporting, a natural extension of Communication Skills, is intended to help the student achieve greater facility in his basic communication skills especially as they relate to formal and informal reporting.

The student is introduced to the practical aspects of preparing reports and communicating within groups. The use of graphs, charts, sketches, diagrams, and drawings to present ideas and significant points is an important part of this course.

Emphasis should be placed upon techniques for collecting and presenting scientific and technical data by means of informal and formal reports, and special types of technical papers. Forms and procedures for technical reports are studied, and general formats for all reports to be submitted in this and other courses are considered. Much of the subject matter for this course may be reports required for technical courses. The subject matter taught in this course should be coordinated with that of concurrent courses.

Major Divisions

	Class Hours
I. Reporting	6
II. Writing Technical Reports	12
III. Illustrating Technical Reports	5
IV. The Research Paper	6
V. Oral Reporting	10
VI. Group Communication and Participation	9
Total	48

I. Reporting
  Units of Instruction
  1. Nature and types of reports
  2. Objective reporting
  3. The problem concept
  4. The scientific method
    a. Meaning of the method
    b. Characteristics of the scientific method
    c. Essentials of scientific style
    d. Importance of accuracy and intellectual honesty in observation and recording
    e. Legal importance of recorded data and log books
  5. The techniques of exposition
    a. Definitions
    b. Progression
    c. Elements of style
    d. Analysis of examples
    e. Methods of slanting a report
  6. Critical evaluation of a report

II. Writing Technical Reports
  Units of Instruction
  1. Characteristics of technical reports
  2. Report functions
  3. Informal reports—short—form reports
    a. Memorandum reports
    b. Business letter reports
    c. Progress reports
    d. Outline reports
  4. The formal report
    a. Arrangement
      (1) Cover and title page
      (2) Table of contents
      (3) Summary or abstracts
      (4) Body of the report
      (5) Bibliography and appendix
      (6) Graphs, drawings, or other illustrations
    b. Preparation
      (1) Collecting, selecting, and arranging material
      (2) Writing and revising the report
  5. Special types of papers
    a. The abstract
    b. Process explanations
    c. The case history
    d. The book review

III. Illustrating Technical Reports
Units of Instruction

1. Illustrations as aids to brevity and clarity
2. Use of technical sketching and drawing
3. Use of pictorial drawings and sketches
4. Use of diagrammatic representation
   a. Electrical diagrams and symbols
   b. Process flow diagrams
   c. Instrumentation diagrams
   d. Bar charts, pie diagrams, and similar presentation of data
5. Graphical presentation of data
   a. Graphs–types of paper
   b. Choice of scale
   c. Points and lines; use of data from graphs
6. Use of photographs
7. Selection of appropriate illustrations
   a. Availability
   b. Cost of preparation
   c. Maximum brevity and clarity of presentation

IV. The Research Paper
Units of Instruction

1. Subject and purpose
2. Sources: bibliographical tools, periodical indices, the library
3. Organizing the paper
   a. A working bibliography
   b. Notes and the outline
   c. The rough draft
   d. Quoting and footnoting
   e. The final paper
4. Oral and written presentation of the paper

V. Oral Reporting
Units of Instruction

1. Organization of material for effective presentation
2. Formal and informal reports
3. The use of notes
4. The use of slides, exhibits
5. Proper use of the voice
6. Elimination of objectionable mannerisms
7. Introductions

VI. Group Communication and Participation
Units of Instruction

1. The problem-solving approach
   a. Stating and analyzing the problem
   b. Proposing solutions
   c. Selecting and implementing a solution
2. Participating in group communication
   a. The chairman–duties and qualifications
   b. Rules of order
   c. The panel discussion and symposium
   d. Group investigation

Texts and References

Baird *and* Knower. *Essentials of General Speech.*

Bordeaux. *How To Talk More Effectively.*

Crouch *and* Zetler. *A Guide to Technical Writing.*

Dean *and* Bryson. *Effective Communication.*

Harwell. *Technical Communications.*

Hays. *Principles of Technical Writing.*

Hicks. *Successful Technical Writing.*

Kegel *and* Stevens. *Communication: Principles and Practices.*

Marder. *The Craft of Technical Writing.*

McCrorie. *The Perceptive Writer, Reader, and Speaker.*

Perrin *and* Smith. *Handbook of Current English.*

Rhodes. *Technical Report Writing.*

Roget. *New Roget's Thesaurus of the English Language.*

Schutte *and* Steinberg. *Communication in Business and Industry.*

Sherman. *Modern Technical Writing.*

Souther. *Technical Report Writing.*

Thompson. *Fundamentals of Communication.*

Warriner *and others. English Grammar and Composition: A Complete Handbook.*

Witty. *How To Become a Better Reader.*

Young *and* Symonik. *Practical English: Introduction to Composition.*

Zetler *and* Crouch. *Successful Communication in Science and Industry.*

Visual Aids

McMurry-Gold Productions, 139 South Beverly Drive, Beverly Hills, Calif. 91603.

Person to Person Communication. 13 minutes, 16 mm., black and white, sound.

National Educational Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Ind. 47405.

Experience as Give and Take. 29 minutes, 16 mm., black and white, sound. Produced by Hayakawa. (Language in Action Series).

Talking Ourselves Into Trouble. 29 minutes, 16 mm., black and white, sound. Produced by Hayakawa. (Language in Action Series).

Words That Don't Inform. 29 minutes, 16 mm., sound. Produced by Hayakawa. (Language in Action Series).

National Safety Council, 425 N. Michigan Avenue, Chicago, Ill. 60601.

It's an Order. 12 minutes, 16 mm., black and white, sound.

FOREST SOILS

Hours Required

Class, 2; Laboratory and/or Field, 3.

Course Description

This course provides the student with an understanding of the importance of soil in relation to forest tree growth. Relevant classroom, laboratory, and field exercises demonstrate to the student the variety of soils; their physical, chemical, and biological properties; soil development and formation; the survey and classification of soils; various geographical forms; the problems of soil loss and its control by soil conservation practices; the nutrient requirements of forest vegetation; and the integration of these factors in the proper management of forest growth. Laboratory exercises teach the student to conduct simple tests and procedures to determine the more basic properties of soil and to interpret its suitability for tree growth and reforestation.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Introduction to Soil Science	1	3
II. Soil Survey and Classification	3	6
III. Physical Aspects of Mineral Soils	3	6
IV. Soil Water	3	6
V. Chemical Aspects of Mineral Soils	4	3
VI. Biological Aspects of Mineral Soils	3	0
VII. Soil Formation and Development	3	6
VIII. Nutrient Requirements and Mineral Nutrition of Forest Vegetation	3	6
IX. Organic Soils	2	0
X. Soil Erosion and Its Control	3	6
XI. Forest Soil Management	4	6
Total	32	48

I. Introduction to Soil Science
  A. Units of Instruction
    1. Definitions of soil
    2. Scope and importance of soil science
    3. History of the study of the soil
  B. Laboratory Project
    Visit several soil pits and examine the major differences in development, drainage, parent material, and profile.

II. Soil Survey and Classification
  A. Units of Instruction
    1. History and development of soil classification
    2. Criteria used in classification systems
    3. Classification systems currently used
    4. The Seventh Approximation—the newly adopted classification system
    5. Soil series, type, phase, association, and catena
    6. Soil survey and mapping
    7. Soil survey reports
    8. Land-use capability classification
    9. Forest site classification and woodland suitability groups
  B. Laboratory Projects
    1. Examine and discuss soil survey reports.
    2. Compile assigned data from a soil survey report.
    3. Discuss symbols and techniques used in soil mapping.
    4. Locate several soil series in the field, using a soil map, and collect samples for future testing.
    5. Examine in detail and discuss a soil type in a pit whose profile has been completely described.

III. Physical Aspects of Mineral Soils
  A. Units of Instruction
    1. Soil separates and soil texture
    2. Soil structure and consistence
    3. Particle density, bulk density, and pore space
    4. Soil air and soil temperature
  B. Laboratory Projects
    1. Prepare soil samples for testing.
    2. Make mechanical analysis of soil samples using Bouyoucos method.

    3. Separate sand fractions into various components by sieving.
    4. Determine soil percentage composition and make textural classification using textural triangle.
    5. Study the determination of soil texture by touch.
    6. Use core sampler to collect samples of soil for bulk density determination.
    7. Prepare soil cores for testing and calculate bulk density and percent pore space.
    8. Make a field examination of various soil structural types and classes

IV. Soil Water
  A. Units of Instruction
    1. Classification and energy relations of soil water
    2. Movement of water into and within the soil
    3. Soil moisture determinations
    4. Soil moisture losses
    5. Soil moisture in relation to plant growth
    6. Soil drainage
      a. Open ditch
      b. Tile
      c. Other methods
    7. Irrigation
      a. Surface
      b. Subsurface
      c. Sprinkler
      d. Water sources
  B. Laboratory Projects
    1. Determine soil moisture content by:
      a. Tensiometer
      b. Resistance blocks
      c. Gravimetric method
    2. Make a laboratory determination of permeability rate.
    3. Demonstrate water movement within the soil, using a glass-sided box.
    4. Demonstrate laboratory determination of field capacity and wilting point.
    5. Make a field inspection of an irrigation system.
    6. Make a field inspection of a drainage system.

V. Chemical Aspects of Mineral Soils
  A. Units of Instruction
    1. Soil reaction: pH, acidity, and alkalinity
    2. Clay minerals and colloids
    3. Cation exchange
    4. Other soil chemical reactions
  B. Laboratory Projects
    1. Make pH determinations by potentiometric and colorimetric tests.
    2. Demonstrate determination of active and reserve hydrogen.
    3. Conduct an experiment which provides evidence of cation exchange in soil.
    4. Demonstrate and practice extraction of soil humus.
    5. Demonstrate cation exchange properties of humus.
    6. Demonstrate dispersing and flocculating properties of variously charged cations.

VI. Biological Aspects of Mineral Soils
  A. Units of Instruction
    1. Plant and animal organisms in the soil
    2. Activities and functions of soil organisms
    3. Accumulation and loss of soil organic matter
    4. Decomposition of organic matter and humus formation
  B. Laboratory Projects
    1. Observe activities of soil macro-organisms in a glass-sided soil observation box.
    2. If equipment is available, examine prepared microscopic slides of soil micro-organisms.

VII. Soil Formation and Development
  A. Units of Instruction
    1. Geologic classification of parent materials
    2. Weathering of rocks and minerals
    3. Primary factors of soil formation
    4. Principal soil-forming processes
    5. The soil profile and diagnostic horizons
  B. Laboratory Projects
    1. Study and describe hand samples of the more important rocks and minerals.
    2. Perform a laboratory exercise to dem-

onstrate mechanical weathering.

3. Perform a laboratory exercise to demonstrate chemical weathering, showing release of nutrients through chemical reaction.
4. Examine soil monoliths for diagnostic horizons used in classification and soil-forming processes and for soil profiles foreign to the area.
5. Make field examinations of selected sites showing the effect on soil formation of differing conditions of parent material, vegetation, relief, and time.
6. Demonstrate and illustrate the use of indicator plants in determining soil characteristics in the field.

VIII. Nutrient Requirements and Mineral Nutrition of Forest Vegetation

A. Units of Instruction
  1. Elements essential to plant growth and their sources
  2. The phenomenon of nutrient uptake
  3. Functions of essential elements in the plant
  4. Physical conditions of soil and plant nutrition
  5. Nutrient deficiency symptoms and problems

B. Laboratory Projects
  1. Show filmstrip and slide illustrations of deficiency symptoms.
  2. Examine plants grown in controlled, nutrient deficient media.
  3. Conduct rapid soil tests for essential elements.
  4. Conduct plant tissue tests for nutrients.

IX. Organic Soils

A. Units of Instruction
  1. Origin, distribution, and importance of organic soils
  2. Classification and use of organic soils
  3. Properties and management of organic soils

B. Laboratory Projects
  1. Make field examinations of peat and muck soils.
  2. Perform laboratory examination of samples of organic soils to determine original plant sources and certain physical properties.
  3. Test organic soil samples for pH and selected elements.

X. Soil Erosion and Its Control

A. Units of Instruction
  1. Agents of erosion
  2. Erosion processes
  3. Control of erosion caused by water
  4. Control of wind erosion
  5. Erosion and forest vegetation

B. Laboratory Projects
  1. Examine various erosion control practices and structures on the site.
  2. Study the conduct of logging operations and the relation of logging road layout to soil properties and erosion hazards.
  3. Study the use of soil maps, woodland suitability groups, topographic maps, and aerial photos in laying-out operations.

XI. Forest Soil Management

A. Units of Instruction
  1. Soil amendments and their uses
  2. Management of forest nursery soils
  3. Management of forest plantation soils
  4. Management of soils under natural forest stands.

B. Laboratory Projects
  1. Laboratory study of soil reaction and its modification.
  2. Examine fertilizer materials. Make calculations related to fertilizer formulation and application.
  3. Visit a forest nursery and observe soil management problems and techniques. Prepare report of observations.
  4. Visit a managed plantation, observe soil management practices, and report on visit.
  5. Visit a managed natural woodland, observe soil management practices, and write a report on the visit.
  6. Visit an unmanaged woodlot and make a written report on suggested soil management practices.

Texts and References

BEAR. *Soils in Relationship to Crop Growth.*
BERGER. *Introductory Soils.*
BLACK. *Soil-Plant Relationships.*
BUCKMAN *and* BRADY. *Nature and Properties of Soils.*
BUNTING. *The Geography of Soil.*

Cook. *Soil Management for Conservation and Production.*

Foster. *Approved Practices in Soil Conservation.*

Jackson *and* Raw. *Life in the Soil.*

Kramer *and* Kozlowski. *Physiology of Trees.*

Millar, Turk, *and* Foth. *Fundamentals of Soil Science.*

Russell. *Soil Conditions and Plant Growth.*

Schwab *and others. Elementary Soil and Water Engineering.*

Tisdale *and* Nelson. *Soil Fertility and Fertilizers.*

U.S.D.A. *Soil Survey Manual.*

U.S.D.A. *Soil: The Yearbook of Agriculture.*

U.S.D.A. *Soils and Men: The Yearbook of Agriculture.*

U.S.D.A. Soil Conservation Service. *Soil Classification: A Comprehensive System, Seventh Approximation.*

Wilde. *Forest Soils.*

Youngberg. *Forest-Soil Relationships in North America.*

Visual Aids

Encyclopaedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Ill. 60091.

Erosion: Leveling the Land. **22 minutes, 16 mm., color, sound.**

Our Soil Resources. **11 minutes, 16 mm., black and white, sound.**

What Is Soil. **13 minutes, 16 mm., black and white or color, sound.**

Marian Ray, 36 Villiers Avenue, Surbiton, Surrey, England.

Soils: Part I: Rocks and Erosion. A filmstrip, color.

Soils: Part II: Plants and Decay. A filmstrip, color.

Soils: Part III: Soil Profiles and Their Formation. A filmstrip, color.

Soils: Part IV: Composition of Soil. A filmstrip, color.

Soils: Part V: Soil and Farming. A filmstrip, color.

Ward's Natural Science Establishment, Inc., P.O. Box 1712, Rochester, N.Y. 14603.

Weathering and Water Cycle. **Dyna-Vue transparancies plus lecture notes, color.**

Note: Samples of various soil types, hand samples, rocks and minerals, slides of micro-organisms, and such related material may be obtained from Ward's Natural Science Establishment, Inc.

TECHNICAL DRAWING

Hours Required

Class, 0; Laboratory, 6.

Course Description

Technical Drawing is designed to introduce the student to basic drafting techniques. The student should develop the ability to produce clear, neat, and legible drafting work. Lettering, sketching, the use of drafting tools and techniques, and orthographic projection are studied. Graphs and charts, and mapping as they apply to forestry are also considered.

Since this is a laboratory course, the student learns by drafting under instructor supervision. Some work may have to be completed outside of regular laboratory periods. Time required for group teaching is usually taken at the beginning of laboratory sessions.

Major Divisions

	Laboratory Hours
I. Lettering	18
II. Instruments and Basic Techniques	12
III. Projections	24
IV. Visual Aids and Reproduction	12
V. Mapping	30
Total	96

I. Lettering
  A. Units of Instruction
    1. Types
    2. Pencils
    3. Guide lines
    4. Strokes
      a. Order
      b. Direction
    5. Spacing
    6. Vertical
    7. Inclined
    8. Title blocks
    9. Inking
    10. Use of lettering guides
  B. Laboratory Projects
    1. Practice the basic vertical, horizontal, slanted, and curved strokes necessary to make letters and numerals.
    2. Practice printing the numerals and each of the letters in the alphabet several times in upper and lower case figures. Do this in vertical and slant lettering forms.
    3. Copy a famous quotation in upper and lower case letters in the form that is most comfortable. (Vertical or inclined letters.) Pay close attention to spacing between letters and sentences.
    4. Practice lettering and spacing of several title blocks, using upper and lower case figures. Use ink on these after they have been penciled in correctly.

II. Instruments and Basic Techniques
  A. Units of Instruction
    1. Drafting tools
      a. Drawing papers
      b. Drawing board
      c. Pencils
      d. T-square
      e. Triangles
      f. Scales
      g. Instrument kit
      h. Curves
      i. Drafting machines
    2. Geometrical construction
      a. Bisecting angles
      b. Perpendicular lines
      c. Polygons
      d. Arcs
      e. Curves
      f. Tangents
      g. Spirals
    3. Dimensioning
      a. Lines
      b. Arrowheads
      c. Figures
      d. Leaders
      e. Finish marks
      f. Contours
      g. Irregular curves
  B. Laboratory Projects
    1. Practice with the drawing instruments by drawing lines, curves, and

figures.

2. Draw several figures to varying scales and label the scale under each.
3. Practice constructing angles, circles, and other geometric figures with the drawing tools.
4. Draw lines of various thicknesses as well as arrowheads and finish marks for practice.
5. Draw irregular curves with the aid of the curve instruments.

III. Projections

- A. Units of Instruction
    1. Orthographic
        a. Primary planes and views
        b. Revolving the planes
        c. Third angle projection
        d. Miter lines
        e. Alternate positions
        f. Dimensioning
    2. Isometric
        a. Axes
        b. Positions
        c. Non-isometric lines
        d. Circles and arcs
    3. Oblique
        a. Axes
        b. Positions
        c. Cavalier style
        d. Cabinet style
        e. Circles and arcs
    4. Perspective drawings
        a. Station points
        b. Vanishing points
        c. Measurements
        d. Circles
    5. Freehand
        a. Tools
        b. Sketching straight lines
        c. Classification of lines
        d. Hidden lines
        e. Circle and arc
        f. Treatment of rounded forms and edges
- B. Laboratory Projects
    1. Draw orthographic projections of specified objects and dimension the various views.
    2. Draw isometric and oblique views of specified objects.
    3. Make perspective drawings of forestry buildings, using both one and two point techniques.
    4. Sketch orthographic, isometric, and oblique views freehand, using only a pencil and coordinate paper.

IV. Visual Aids and Reproduction

- A. Units of Instruction
    1. Visual aids
        a. Graphs
        b. Charts
        c. Nomographs
    2. Reproduction
        a. Printing processes
        b. Tracings
        c. Copies
- B. Laboratory Projects
    1. Draw a graph showing the vertical growth of a timber stand over a period of several years. Use data from a forestry text.
    2. Draw bar and pie charts from data related to the field of forestry.
    3. Construct a nomograph related to information from some field of forestry.
    4. Trace on tracing paper a drawing that has previously been inked.
    5. Students may be required to write a report on the several methods of reproducing drafting work.
    6. Draw a flow diagram of a large sawmill operation, showing buildings, machinery location, and yard layout. Dimension and label completely.

V. Mapping

- A. Units of Instruction
    1. Conventional symbols
        a. Vegetation
        b. Water
        c. Transportation routes
        d. Buildings
        e. Others
    2. Mapping details
        a. Titles
        b. Scales
        c. Borders
        d. North points
    3. Mapping techniques
        a. Horizontal traverses
        b. Profiles
        c. Topographic maps

B. Laboratory Projects

1. Plot a traverse, using the protractor and scale method. Include all details necessary for registering the plot in the county Registry of Deeds office.
2. Draw a profile of a forest park road. Show such details as drainage, slopes, elevations, and a typical cross section of the finished road bed.
3. Make a topographic map of a large recreation area. Include contour lines, high points, and water ways. Show water, vegetation, routes, and buildings with different colors and draw a legend to indicate these.

Texts and References

ARNOLD *and others. Introductory Graphics.*

FRENCH *and* VIERCK. *Fundamentals of Engineering Drawing.*

GIESECKE, MITCHELL, *and* SPENCER. *Technical Drawing.*

HOELSCHER *and* SPRINGER. *Engineering Drawing and Geometry.*

HOELSCHER, SPRINGER, *and* DOBROVOLNY. *Basic Drawing for Engineering Technology.*

HUEY. *Introductory Drafting and Mapping Workbook for Students in Business and Science.*

LUZADDER. *Basic Graphics.*

MATSON. *Elements of Mapping.*

PARE. *Engineering Drawing.*

SPRINGER *and others. Basic Graphics: Drawing and Descriptive Geometry.*

ZOZZORA. *Engineering Drawing.*

Visual Aids

Chicago Board of Education, 228 North LaSalle Street, Chicago, Ill. 60600.

The Draftsman. 11 minutes, 16 mm., black and white, sound.

Coronet Films, Coronet Building, Chicago, Ill. 60601.

The Language of Graphs. 14 minutes, 16 mm., black and white, sound.

McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N.Y. 10036.

According to Plan: Introduction to Engineering Drawing. 9 minutes, 16 mm., black and white, sound.

Orthographic Projection. 18 minutes, 16 mm., black and white, sound.

Pictorial Sketching. 11 minutes, 16 mm., black and white, sound.

Scales: Flat and Triangular. 35 mm., filmstrip, 37 frames, black and white.

Selection of Dimensions. 18 minutes, 16 mm., black and white, sound.

The Drawing and the Shop. 15 minutes, 16 mm., black and white, sound.

Pennsylvania State College, Film Library, State College, Pa. 16801.

Drafting Tips. 28 minutes, 16 mm., black and white, sound.

Purdue Research Foundation, Lafayette, Ind. 47901.

Applied Geometry. 17 minutes, 16 mm., black and white, silent.

Capital Letters. 21 minutes, 16 mm., black and white, sound.

Freehand Drafting. 12 minutes, 16 mm., black and white, silent.

Ink Work and Tracing. 31 minutes, 16 mm., black and white, silent.

Lowercase Letters. 17 minutes, 16 mm., black and white, silent.

Pictorial Drawing. 22 minutes, 16 mm., black and white, silent.

Sectional Views. 22 minutes, 16 mm., black and white, silent.

Testing of T-Square and Triangles. 11 minutes, 16 mm., black and white, silent.

FOREST BUSINESS METHODS

Hours Required

Class, 2; Laboratory, 3.

Course Description

This survey course in the organization and operation of the forest as a small business enterprise is designed to acquaint the student with record keeping, timber sales, management costs, and stumpage valuation. Basic terminology used in forest business is presented. The importance of keeping records is stressed. Various kinds of taxes are identified and compared. The student learns how to report timber receipts and expenditures when preparing a Federal Income Tax Report.

Laws as they relate to a forest enterprise are briefly considered, and the State's forest laws are covered in some detail.

The real estate business as related to the sale and leasing of a forest property is briefly discussed. The services that can be provided by consulting foresters, attorneys, bankers, accountants, and business consultants are identified and discussed.

Major Divisions

	Hours	
	Class	*Laboratory*
I. The Nature of Forest Business	17	27
II. The Nature of Taxation	5	6
III. The Nature of Forest Law	5	6
IV. The Nature of Real Estate	5	9
Total	32	48

I. The Nature of Forest Business
  A. Units of Instruction
    1. Forest business records
      a. Bookkeeping records
      b. Labor records
      c. Equipment records
      d. Inventory records
      e. Timber tract records
      f. Cutting and forest improvement records
      g. Maps
    2. Timber sales
      a. Preparation of sale data
      b. Sealed bids
      c. Lump-sum sales
      d. Closing the sale
    3. Miscellaneous income
      a. Minerals
      b. Leases
      c. Rights-of-way
    4. Management costs
      a. Forest management costs
      b. Insurance costs
      c. Planting and cultural work costs
      d. Fire prevention, presuppression, and suppression costs
      e. Interest and discount
      f. Depreciation
    5. Stumpage value and appraisal
      a. Overturn method
      b. Investment method
      c. Fair market value
  B. Laboratory Projects
    1. Solve practical problems on:
      a. Bookkeeping
      b. Inventory of the equipment assigned to the Forest Technology Department or to a local forestry organization.
      c. Indexing a series of maps.
      d. Analysis of several kinds of timber sales.
      e. Determining the interest rate and depreciation on several pieces of heavy equipment.
      f. Calculating the stumpage value on a tract of timber, using the overturn method.
    2. Make a field trip to the office of a large forest land owner to observe the methods of recordkeeping.

II. The Nature of Taxation
  A. Units of Instruction
    1. Property tax
    2. Sales tax
    3. Income tax
    4. Ad Valorem tax
    5. Yield tax
    6. Tax assessments

B. Laboratory Projects
  1. Make a field trip to a local Tax Assessor's office.
  2. Demonstrate tax assessing techniques.
  3. Calculate a hypothetical Federal income tax for a small forest enterprise.
  4. Make a comparison between an Ad Valorem tax and a yield tax for a forest property.

III. The Nature of Forest Law
  A. Units of Instruction
    1. Contracts
      a. Basic requirements
      b. Objectives
      c. Provisions
      d. Options
      e. Leases
      f. Licenses
      g. Subcontracting
      h. Trespasses
    2. Review of State forest laws
  B. Laboratory Projects
    1. Have a local attorney discuss the legal aspects of forest enterprises.
    2. Compile a summary of the forest laws of the State.
    3. Study cases of how forest law applies to the management and operation of public or private forest agencies.

IV. The Nature of Real Estate
  A. Units of Instruction
    1. Deeds
    2. Sale contracts
    3. Mortgages
    4. Options
    5. Recording
    6. Title searching and abstracting of title
  B. Laboratory Projects
    1. Make a field trip to a local Recorder of Deeds office and study the services of this office.
    2. Make a title search of a forest property.
    3. Write an abstract of title for a forest property.
    4. Analyze deeds for forest properties.

Texts and References

BABB *and* **MARTIN.** *Business Law.*

BAUER *and* **DARBY.** *Elementary Accounting.*

DUERR. *Fundamentals of Forestry Economics.*

FALK. *Timber and Forest Products Law.*

RAGAN. *Financial Recordkeeping for Small Stores.*

SEMENOW. *Questions and Answers on Real Estate.*

U.S. DEPARTMENT OF LABOR. Small Business Administration. *The Why and What of Bookkeeping.*

VARDAMAN. *Tree Farm Business Management.*

WILDLIFE ECOLOGY

Hours Required

Class, 1; Laboratory and/or Field, 4.

Course Description

An introductory course in wildlife ecology upon which the management of wildlife resources may be based. It is intended as a supplemental course for the forest technician to increase his understanding of forest management practices and basic ecological knowledge as they relate to wildlife management practices. Emphasis is placed upon the terrestrial communities, and predominantly on the wildlife of forest and range lands.

This course should provide a good balance of theory of wildlife populations and manipulations with practical, *interesting* field exercises or problems in order to be most effective. The field exercises can be planned and varied to take maximum advantage of current species management in the area in which the course is given. The field exercises herein described are particularly adapted to a local area, and are provided as an example of what such field exercises may be.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. History of Wildlife Management and Values	1	4
II. The Biotic Community and Ecosystem	2	8
III. Wildlife Habitat	2	8
IV. Types of Game in the Local Area	4	16
V. Characteristics of Wildlife Populations	2	4
VI. Methods of Studying Wildlife Populations	2	14
VII. Wildlife Management and Public Relations	3	10
Total	16	64

I. History of Wildlife Management and Values
  A. Units of Instruction
    1. Early European attempts at management
    2. Colonial management
      a. Extinction of some species
      b. Establishment of Wildlife Protective Association
    3. Establishment of game as a recreational unit
    4. Value to local and State economy in dollars by species
    5. Scientific value
    6. Establishment of various funds for research and management
  B. Laboratory Projects
    1. Make a field trip to the State Fish and Game headquarters or some other unit with management responsibilities and discuss how the unit operates. Economic operations should be stressed.
    2. Have each student submit a report on the operations of the State department or unit which was discussed.

II. The Biotic Community and Ecosystem
  A. Units of Instruction
    1. Function of the ecosystem
    2. Hydrologic cycle
    3. Development of communities
      a. Climax vegetation
      b. Successional vegetation
    4. Biotic communities
      a. Faunal regions and characteristic game mammals
      b. Biomes and game mammals
  B. Laboratory Projects
    1. Identify several common game mammals and furbearers by skull characteristics, using standard identification keys.
    2. Identify several common upland game birds and waterfowl, using standard identification keys.
    3. Submit a report of the known habits and characteristics of the upland game birds and mammals studied.
    4. Identify furbearers and game animals

under field conditions by tracks, fur remnants, and habitat requirements.
5. Establish the identity of waterfowl and upland game birds by field observation.

III. Wildlife Habitat
- A. Units of Instruction
  - 1. Carrying capacity
    - a. Food requirements
    - b. Effects on plant growth
    - c. Dietary requirements
    - d. Food values
    - e. Disturbance of vegetation and food production
    - f. Improvement of food supplies
    - g. Cover requirements
    - h. Water requirements
  - 2. Limiting factors
  - 3. Hydroseres and aquatic animals
  - 4. Grassland succession and game abundance
  - 5. Forest succession and game abundance
- B. Laboratory Projects
  - 1. Investigate food plots placed by forest industries or game management agencies.
  - 2. Discuss and report on species being managed, including the economic results, in terms of numbers and utility of plots.
  - 3. Investigate big game animal exclosures as they affect vegetative growth.
  - 4. Construct brush piles in forest cutting areas and improve the fish habitat in a local stream or river by the creation of obstructions.

IV. Types of Game in the Local Area
- A. Units of Instruction
  - 1. Farm game populations
    - a. Types of game found in the community
    - b. Feeding habits, cover requirements, and breeding ground
    - c. Conservation practices and laws
  - 2. Forest game and furbearers
    - a. Types found in local area
    - b. Food habits and breeding grounds
    - c. Conservation practices and laws
  - 3. Migratory game birds and waterfowl
    - a. Types found in community and State
    - b. Feeding and breeding grounds
    - c. Federal and State laws
  - 4. Upland game birds
    - a. Types found in the State
    - b. Feeding and breeding areas and habits
    - c. State laws and conservation practices
  - 5. Fish
    - a. Types of game fish in the State
    - b. Habitat requirements and reproduction
    - c. State laws and practices
- B. Laboratory Projects
  - 1. Make a trip with a representative of the State or Federal wildlife agency into areas where the various types of wildlife or evidences of wildlife can be seen, such as a beaver pond. Discuss furbearers, trout, waterfowl, and forest management and their relationships on these sites.
  - 2. Report on the various management activities required for the reproduction and management of species associations.
  - 3. Make a field trip to a State or Federal fish hatchery to discuss fishery management and research being conducted there.
  - 4. Man a deer checking station during hunting season and classify the deer as to sex, condition, and age.
  - 5. Make an economic evaluation of the businesses supported by big game species in the area.

V. Characteristics of Wildlife Populations
- A. Units of Instruction
  - 1. Density
  - 2. Structure
    - a. Clutch and litter size
    - b. Numbers of litters and clutches
    - c. Breeding characteristics
    - d. Sex ratios and age
    - e. Predation
    - f. Disease and parasites
    - g. Accidents
    - h. Weather
    - i. Starvation
    - j. Stress due to overpopulation
    - k. Hunting

3. Interaction of population characteristics
    a. Turnover
    b. Productivity and yield
    c. Stability
    d. Stocking methods and costs
    e. Law and enforcement

B. Laboratory Projects
  1. Visit a State or Federal wildlife agency experimental area and determine the effects of various factors upon numbers of upland game birds and game mammals.
  2. Write a report on a selected upland species as to its characteristics and rate of survival in the local area.
  3. Make a field trip with a representative of the Federal or State Fish and Game Department to observe various methods and costs of stocking game animals and game fish.

VI. Methods of Studying Wildlife Populations

A. Units of Instruction
  1. Census
    a. Waterfowl
    b. Tracks and signs
    c. Sample area counts
  2. Wildlife movement
    a. Seasonal migration
    b. Emigrations
    c. Electronic tracking

B. Laboratory Projects
  1. Make a census of waterfowl in a given waterway by direct enumeration, using State game department aerial photographs or Fish and Wildlife Service photographs.
  2. Submit a report on this method of census and discuss its accuracy and cost as opposed to field methods.
  3. Make a direct enumeration census of rabbits in a given area, using the drive technique.
  4. Make a direct enumeration census of the deer population in a given area, using the drive technique. This could be done in the fall to give an estimate of the sex ratio.

VII. Wildlife Management and Public Relations

A. Units of Instruction
  1. Management problems
    a. Native species management
    b. Stocking techniques
    c. Posting of lands
    d. Law enforcement
  2. Landowner problems
    a. Insurance requirements
    b. Vandalism
    c. Nuisance
    d. Conservation practices and game management
  3. Sportsmen problems
    a. Understanding landowner problems
    b. Understanding game management costs, practices, and enforcement
    c. License fees
  4. Cooperative arrangements
    a. Rental and leasing
    b. Public acquisition
    c. Preserves

B. Laboratory Projects
  1. Have students work in groups of two to conduct interviews with conservation officers, game biologists, at least five landowners, and five sportsmen. Construct a representative list of questions designed to assist the students to understand the principles of game management and the underlying problems of landowner-sportsmen relations.
  2. Present a class report explaining the significance of the findings and possible changes which could be made to bring about more and better understanding of intergroup problems in wildlife management and land use.

Texts and References

ALLEN. *Our Wildlife Legacy.*
BURT and GROSSENHEIDER. *A Field Guide to the Mammals.*
CAHALANE. *Mammals of North America.*
DASMANN. *Environmental Conservation.*
DASMANN. *Wildlife Biology.*
LEOPOLD. *A Sand Country Almanac.*
LEOPOLD. *Game Management.*
MURIE. *A Field Guide to the Mammals.*
OSBORNE. *Our Crowded Planet.*
PETERSON. *A Field Guide to the Birds.*
STAINS. *Game Biology and Game Management—A Laboratory Manual.*
TREFETHEN. *Wildlife Management and Conservation.*

Trippensee. *Wildlife Management. Volumes I and II.*
Wing. *Practices of Wildlife Conservation.*

Visual Aids

Contemporary Films, Inc., 267 West 25th Street, New York, N.Y. 10001.
Quetico. 22 minutes, 16 mm., color, sound.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Ill. 60604.
Conservation and Balance in Nature. 18 minutes, 16 mm., color, sound.

McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York, N.Y. 10018.
Plant and Animal Distribution. 28 minutes, 16 mm., color, sound.
World in a Marsh. 22 minutes, 16 mm., color, sound.

Motion Picture Production, University of California Extension, Berkeley, Calif. 94700.
Polar Ecology. 23 minutes, 16 mm., color, sound.

Ohio Department of Natural Resources Information and Education Department, 1106 Ohio Departments Building, Columbus, Ohio 43215.
Wildlife at Home. 14½ minutes, 16 mm., color, sound.

U.S.D.A. Forest Service, Motion Picture Service, Washington, D.C. 20250.
Wildlife and the Human Touch. 19 minutes, 16 mm., black and white or color, sound.

Wisconsin Conservation Department, Film Library, Madison, Wisc. 53700.
Red 14. 28 minutes, 16 mm., color, sound.

General Courses

COMMUNICATION SKILLS

Hours Required

Class, 3; Laboratory, 0.

Course Description

This course emphasizes exercises in writing, speaking, and listening. Analysis is made of each student's strengths and weaknesses. The pattern of instruction is geared principally to helping students improve skills in areas where common weaknesses are found. The time allotments for the various elements within major divisions will depend upon the background of the class.

A brief consideration of technical reporting is included early in the course because of its importance in the orientation of the technician to his development and use of communication skills.

Major Divisions

	Class Hours
I. Communication and the Technical Specialist	2
II. Sentence Structure	6
III. Using Resource Materials	4
IV. Written Expression	20
V. Talking and Listening	10
VI. Improving Reading Efficiency	6
Total	48

I. Communication and the Technical Specialist
Units of Instruction
1. Why the technical specialist must be proficient in the art of communication
2. Why written communication is an essential skill
   a. Statements and facts
   b. Expression of ideas
   c. Technical reporting
      (1) Formal
      (2) Informal
   d. Use of graphics to illustrate written communications
3. Why oral communication is an essential skill.
   a. Person to person expression of ideas and thoughts
   b. Verbal reporting
4. Diagnostic tests

II. Sentence Structure
Units of Instruction
1. Review of basic parts of speech
2. What makes complete sentences
3. Use and placement of modifiers, phrases, and clauses
4. Conciseness
5. Exercises in sentence structure

III. Using Resource Materials
Units of Instruction
1. Orientation in the use of the school library
   a. Location of reference materials, *Reader's Guide to Periodical Literature*, etc.
   b. Classification for effective use
      (1) Dewey Decimal System
      (2) Library of Congress System
2. Dictionaries
   a. Types of dictionaries
   b. How to use dictionaries
   c. Diacritical markings and accent marks
3. Other reference sources
   a. Technical manuals and pamphlets
   b. Bibliographies
   c. Periodicals
   d. *Industrial Arts Index*
4. Exercises in the use of resource materials
   a. *Reader's Guide to Periodical Literature*
   b. Atlases
   c. Encyclopedias
   d. Others

IV. Written Expression
(emphasis on student exercises)

Units of Instruction

1. Diagnostic test
2. Paragraphs
   a. Development
   b. Topic sentence
   c. Unity of coherence
3. Mode of presentation
   a. Using inductive and deductive reasoning
   b. Figures of speech
   c. Analogies
   d. Syllogisms
   e. Showing cause and effect
   f. Others
4. Exercises in writing paragraphs
5. Descriptive reporting
   a. Organization and planning
   b. Emphasis on sequence, continuity, and delimitation to pertinent data of information
6. Letter writing
   a. Business letters
   b. Personal letters
7. Mechanics
   a. Capitalization
   b. Punctuation—when to use
      (1) Period, question mark, and exclamation point
      (2) Comma
      (3) Semicolon
      (4) Colon
      (5) Dash
      (6) Parentheses
      (7) Apostrophe
   c. Spelling
      (1) Word division—syllabification
      (2) Prefixes and suffixes
      (3) Word analysis and meaning—context clues, phonetics, etc.
8. Exercises in the mechanics of written expression

V. Talking and Listening
(emphasis on student exercises)

Units of Instruction

1. Diagnostic testing
2. Organization of topics or subjects
3. Directness in speaking
4. Gesticulation and use of objects to illustrate
5. Conversation courtesies
6. Listening faults
7. Taking notes
8. Understanding words through context clues
9. Exercises in talking and listening

VI. Improving Reading Efficiency

Units of Instruction

1. Diagnostic test
2. Reading habits
   a. Correct reading posture
   b. Light sources and intensity
   c. Developing proper eye span and movement
   d. Scanning
   e. Topic sentence reading
3. Footnotes, index, bibliography, cross reference, etc.
4. Techniques of summary
   a. Outline
   b. Digest or brief
   c. Critique
5. Exercise in reading improvement
   a. Reading for speed
   b. Reading for comprehension

Texts and References

Baird *and* Knower. *Essentials of General Speech.*
Beardsley. *Thinking Straight.*
Bordeaux. *How To Talk More Effectively.*
Buckley *and* McAvory. *American College Handbook of English Fundamentals.*
Crouch *and* Zetler. *Guide to Technical Writing.*
Dean *and* Bryson. *Effective Communication.*
DeVitis *and* Warner. *Words in Context: A Vocabulary Builder.*
Gerber. *The Writer's Resource Book.*
Harwell. *Technical Communication.*
Kegel *and* Stevens. *Communication: Principles and Practices.*
Marder. *The Craft of Technical Writing.*
McCrorie. *The Perceptive Writer, Reader, and Speaker.*
Perrin *and* Smith. *Handbook of Current English.*
Roget. *New Roget's Thesaurus of the English Language.*
Schutte *and* Steinberg. *Communication in Business and Industry.*
Stewart *and others. Business English and Communication.*
Strunk *and* White. *The Elements of Style.*
Thompson. *Fundamentals of Communication.*
Tracy *and* Jennings. *Handbook for Technical Writers.*
Warriner *and others. English Grammar and Composition: A Complete Handbook.*
Witty. *How To Become a Better Reader.*
Young *and* Symonik. *Practical English: Introduction to Composition.*
Zetler *and* Crouch. *Successful Communication in Science and Industry.*

Visual Aids

Coronet Films, Inc., Coronet Building, Chicago, Ill. 60601.

Improve Your Punctuation. 11 minutes, 16 mm., black and white or color, sound.

DuArt Film Laboratories, Inc., 245 West 55th Street, New York, N.Y. 10019.

Effective Writing. 19 minutes, 16 mm., black and white, sound.

Practical English Usage I. 30 minutes for each lecure, 16 mm., black and white, sound:

Lecture 1: The Tools of Language.

Lecture 10: Writing Clear Sentences: Making Words Agree.

Lecture 13: Dressing Up Sentences: Parallelism: Avoidance of Shifts.

Lecture 14: Dressing Up Sentences: Word Economy (Word Reduction).

Lecture 15: Dressing Up Sentences: Variation.

Lecture 16: Dressing Up Sentences: Vocabulary.

National Education Television Film Service, Audio-Visual Center, Indiana University, Bloomington, Ind. 47405.

Dialects. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series).

How To Say What You Mean. 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

Language and Writing. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series).

The Definition of Language. 29 minutes, 16 mm., sound. Produced by Henry Lee Smith. (Language in Linguistics Series.)

The Task of the Listener. 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

What Is the Meaning? 29 minutes, 16 mm., sound. Produced by S. I. Hayakawa. (Language in Action Series).

ELEMENTARY BUSINESS MANAGEMENT

Hours Required

Class, 2; Laboratory and/or Field, 3.

Course Description

This is an elementary study of the principles of the organization and management of business enterprises. Specialized business activities such as data processing, application of computers, business ethics, personnel management, marketing, credit management, and production control are introduced and discussed from a pragmatic standpoint.

As the various topics are introduced, the meaning and underlying principles of each, and the role each plays in forest technology should be emphasized. As part of the course, students should be encouraged to seek out, examine, and interpret selected forest enterprises with reference to their organizational and managerial effectiveness.

Guest lecturers from local industries are invited to discuss practical illustrations of principles under consideration in the course. Laboratory sessions allow time for questions and student participation. Field trips to area establishments are conducted to observe offices and procedures, as well as to hear presentations by management personnel.

In addition to guest lecturers and trips at appropriate times, it is recommended that the laboratory sessions involve workbook study and discussion of the topics presented in the lectures.

Major Divisions

	Hours	
	Class	*Laboratory and/or field*
I. Introduction to Business and Our Economic System	2	3
II. Business Ownership	3	3
III. The Organizational Structure and Management Processes of Business	4	9
IV. Factors of Decision-Making	4	6
V. Labor-Management Relations	4	6
VI. Acquisition and Organization of the Facilities for Production	5	9
VII. The Marketing Process	8	9
VIII. Institutions Affecting Business	2	3
Total	32	48

I. Introduction to Business and Our Economic System
  A. Units of Instruction
    1. Why business exists
      a. Historical need and growth of business
      b. Classifications of business organizations
      c. Opportunities in the business field
    2. The American economic system
      a. The nature of economics
      b. Measures of economic activity
        (1) Gross national product
        (2) National income
        (3) Disposable personal income
        (4) Employment and unemployment
      c. Characteristics of modern business
        (1) Specialization
        (2) Interdependence
        (3) Mass production
        (4) Business cycles
  B. Laboratory Project
    In the introductory unit, a student workbook provides the basis for the laboratory, with additional local illustrations by the instructor and students.

II. Business Ownership
  A. Units of Instruction
    1. The small business enterprise
      a. Single proprietorship and partnership

    - b. Corporations and the joint stock company
    - c. Business trusts, joint ventures, and cooperatives
  - 2. Problems of owning and operating your own business
  - 3. Sources of business information
    - a. Private
    - b. State
    - c. Federal
  - 4. The small business and the future
- B. Laboratory Projects
  - 1. Complete the related workbook unit.
  - 2. Visit a local proprietorship and a local partnership, if possible. A written report on the information obtained should be prepared by each student.

III. The Organizational Structure and Management Processes of Business

- A. Units of Instruction
  - 1. Selecting the form or organization
    - a. Concepts of organizational planning
    - b. Formal and informal organizations
  - 2. Line and staff functions—organizational charts
  - 3. General management functions
    - a. Management guides
    - b. Qualities of leadership
  - 4. Office administration
    - a. Physical facilities
    - b. Office operations
    - c. Automation and its effect on the office
- B. Laboratory Projects
  - 1. Complete the related workbook unit.
  - 2. Invite a guest speaker from a local corporation to discuss organizational charts and procedures; the purposes and advantages of each.

IV. Factors of Decision-Making

- A. Units of Instruction
  - 1. Accounting records and business
    - a. The function of accounting
    - b. Types of data furnished by the accounting department
      - (1) Income statement
      - (2) Balance sheet statement
      - (3) Tax statements
    - c. The use of budgets
      - (1) Analysis of budgets
      - (2) Budgeting and linear programming
  - 2. Research and statistics
    - a. Research
    - b. Forecasting
    - c. Statistical data—averages
      - (1) Mean
      - (2) Median
      - (3) Mode
  - 3. Risk and uncertainty
    - a. Decision-making under risk and uncertainty
    - b. Uncertainty precautions—defenses against uncertainty
- B. Laboratory Projects
  - 1. Complete the related workbook unit.
  - 2. Visit the accounting department of a local business to see forms and procedures used, and submit a written report.

V. Labor-Management Relations

- A. Units of Instruction
  - 1. Personnel management
    - a. Job analysis
    - b. Employee selection and placement
    - c. Employee training
  - 2. Wage and salary administration
    - a. Theory of wages
    - b. Methods of wage payments
    - c. Fringe benefits
    - d. Maintaining high morale
  - 3. The labor movement today
    - a. Growth and development of labor unions
    - b. Labor legislation
    - c. Collective bargaining
    - d. Settlement of labor disputes
- B. Laboratory Projects
  - 1. Complete the related workbook unit.
  - 2. Invite the personnel manager of a local business to discuss his application of various management techniques.
  - 3. Invite a guest speaker from a local union to discuss union services and labor-management relations.

VI. Acquisition and Organization of the Facilities for Production

- A. Units of Instruction
  - 1. Capital

a. The role of capital
b. The amount of capital to use
c. Savings vs. credit
d. Sources of credit
(1) Security exchanges
(2) Long-term capital securities
(3) Businesses and banks
(4) Public and other sources
(5) Leasing as a source of capital
2. The acquisition of a business
a. Choice of location
b. Buying a business
c. Renting a business
d. Costs and returns related to size of business
3. Factors of production
a. Plant layout
b. Characteristics of production
(1) Raw material purchasing
(2) Inventory control
c. Production processes
d. Production control
e. Horizontal vs. vertical diversification of production processes
B. Laboratory Projects
1. Complete the related workbook unit.
2. Invite a representative of a local bank to discuss capital sources and limitations.
3. Make a field trip to a local production unit to study layout, materials handling, and production control. A written report from each student covering the principles observed should be required.

VII. The Marketing Process
A. Units of Instruction
1. Functions of marketing—channels of distribution
2. Costs of marketing
a. Pricing in merchandising
b. Pricing by wholesalers—market spread between wholesale and retail levels
c. Expense control in merchandising and retailing
3. The consumer market
a. Customer relations
b. Merchandising
(1) Retailer
(2) Wholesaler
c. Service businesses
d. Characteristics of retailing
(1) Classification of retail outlets
(2) Functions performed by the retailer
e. Market research
4. Sales management
a. Personal selling in modern business
b. Fundamentals of selling
c. Types of sales organizations
d. Trends in sales management
B. Laboratory Projects
1. Complete the related workbook unit.
2. Visit a local lumber yard to learn pricing policies, sales plans, and promotional techniques. A report from each student should be required.
3. Invite the sales manager of a local industry to discuss his sales organization.

VIII. Institutions Affecting Business
A. Units of Instruction
1. Government
a. The function of government
b. Government regulation of business
c. Government aids to business
d. Taxation
2. Law and ethics
a. Modern business and the law
b. Ethics and morality in business practice
c. Making business more professional
B. Laboratory Projects
1. Complete workbook unit.
2. Appropriate discussion and illustration by the instructor

Texts and References

Broom *and* Longenecker. *Small Business Management.*
Eells. *The Meaning of Modern Business.*
Glos *and* Baker. *Introduction to Business.*
Glos *and* Baker. *Teacher's Manual for Introduction to Business.*
Glos *and* Baker. *Workbook for Introduction to Business.*
Hart. *Business in a Dynamic Society.*
Kelley *and* Lawyer. *How To Organize and Operate a Small Business.*
Newman *and* Summer. *The Process of Management.*
Shilt *and* Wilson. *Business Principles and Management.*
Shilt *and* Wilson. *Teacher's Manual for Business Principles and Management.*
Shilt *and* Wilson. *Workbook for Business Principles and Management.*

YODER. *Personnel Management and Industrial Relations.*

Visual Aids

Business Education Films, 4607 16th Avenue, Brooklyn, N.Y. 11719.

It's Good Business. 35 minutes, 16 mm., black and white, 115 frames.

Modern Talking Picture Service, Inc., 235 Stuart Street, Boston, Mass. 02100.

Credit—Man's Confidence in Man. 30 minutes, 16 mm., black and white, sound.

PERSONNEL MANAGEMENT

Hours Required

Class, 3; Laboratory, 0.

Course Description

An elementary course on the basic principles of organization for effective leadership and personnel management. The history and development of personnel management in our industrial society are explored as they pertain to selection of personnel; delegation of responsibility; psychology of motivating, training, and directing people; morale; and dealing with unions and other organizational groups.

A major objective of the course is to provide the student with a knowledge of those personnel management principles and practices which have proved sound in the light of research and company experiences. Extensive use of case studies should be made.

Major Divisions

		Class Hours
I.	Role of Personnel Management	1
II.	The Personnel Program	2
III.	Organization of Personnel	2
IV.	Organization of the Job	3
V.	Staffing the Organization	2
VI.	Selection of Personnel	2
VII.	Orientation and Training	4
VIII.	Changes in Employee Placement	2
IX.	Supervisory Development	2
X.	Performance Evaluation	3
XI.	Motivation	4
XII.	Communications	2
XIII.	Supervision	3
XIV.	The Working Group	1
XV.	Employee Adjustment and Morale	3
XVI.	Discipline	3
XVII.	Union and Its Role	2
XVIII.	Union–Management Relations	2
XIX.	Remuneration	3
XX.	Employee Security	2
	Total	48

I. Role of Personnel Management
  Units of Instruction
  1. Contributions of personnel management
  2. Nature and development of the personnel field
  3. Personnel management as a field of study

II. The Personnel Program
  Units of Instruction
  1. Management process
  2. Nature of the personnel program
  3. Developing the program
  4. Translating the personnel program into practice

III. Organization of Personnel
  Units of Instruction
  1. Nature and function of an organization
  2. Organizational structure
  3. Line and staff relationships
  4. Organizational and human behavior

IV. Organization of the Job
  Units of Instruction
  1. Nature and function of the job
  2. Work organization and the job
  3. Describing the job
  4. Job analysis

V. Staffing the Organization
  Units of Instruction
  1. Anticipating personnel requirements
  2. Locating qualified personnel
  3. Policies relating to recruitment

VI. Selection of Personnel
  Units of Instruction
  1. Role of personnel program in selection
  2. Employment interviewing
  3. Other methods of selection
  4. Employment decision

VII. Orientation and Training
  Units of Instruction
  1. Orientation
  2. Training program
  3. Psychology of learning
  4. Evaluation of training effectiveness

VIII. Changes in Employee Placement
  Units of Instruction
  1. Nature of placement changes
  2. Seniority considerations

3. Policies and procedures relating to placement changes

IX. Supervisory Development
Units of Instruction
1. Nature of supervisory development
2. Supervisory development program
3. Methods of developing supervisors
4. Administering the development program

X. Performance Development
Units of Instruction
1. Process of evaluation
2. Establishing an evaluation program
3. Utilization of performance evaluation data

XI. Motivation
Units of Instruction
1. Traditional and modern views
2. Human needs—Maslow's Theory
3. Satisfying human needs
4. Organizational environment and motivation

XII. Communications
Units of Instruction
1. Communications process
2. Communications and organizational structure
3. Communication media
4. Barriers to communications
5. Developing and maintaining effective communications

XIII. Supervision
Units of Instruction
1. Leadership in the organization
2. Supervisor's role
3. Characteristics of the effective supervisor
4. Improving supervisory leadership

XIV. The Working Group
Units of Instruction
1. Characteristics of work groups
2. Factors influencing behavior of work groups

XV. Employee Adjustment and Morale
Units of Instruction
1. Problems of employee adjustment
2. Symptoms of emotional problems
3. Employee counseling
4. Developing good morale

XVI. Discipline
Units of Instruction
1. Disciplinary actions
2. Employee grievances
3. Formal grievance procedures

XVII. Union and Its Role
Units of Instruction
1. Function of the union
2. Growth of organized labor
3. Union organization and leadership
4. Current problems and goals of unions

XVIII. Union–Management Relations
Units of Instruction
1. Developing bargaining relationship
2. Union security and recognition
3. Agreement negotiations
4. Government controls

XIX. Remuneration
Units of Instruction
1. Wage and salary administration
2. Financial incentives
3. Job evaluation

XX. Employee Security
Units of Instruction
1. Health and safety
2. Fringe benefits
3. Retirement plans

Texts and References

CRUDEN *and* SHERMAN. *Personnel Management.*
CRUDEN *and* SHERMAN. *Readings in Personnel Management.*
ELLIS. *The Transfer of Learning.*
GAGNE. *The Conditions of Learning.*
MAIER. *Principles of Human Relations.*
MASLOW. *Motivation and Personality.*
PARKINSON. *Parkinson's Law.*
U.S. DEPARTMENT OF LABOR. *Industrial Relations and Wage Terms.*
U.S. DEPARTMENT OF LABOR. *Dictionary of Occupational Titles.*
WHYTE. *Men at Work.*

ELEMENTS OF SOCIAL SCIENCE

Hours Required

Class, 3; Laboratory, 0.

Course Description

Elements of Social Science is an elementary study of the interaction of man and his immediate society, and the organization of social groups and cultures. Individual and group behavior as they are influenced by the customs and institutions of the rural setting are emphasized. The course aims to prepare the student to better cope with specific social problems by having an understanding of the general why and how societies are structured as they are, how people function in groups, and some sense of the pervasiveness and antiquity of the culture which both directs and limits the growth characteristics of a society.

This course is designed on the assumptions that (1) the student will have made little or no formal study of the social sciences and (2) the orientation should be practical; that is, it should convey immediately useful concepts and information. Hence the suggested format of the course that presents clusters of ideas is intended to provide insight into the psychological growth process and the development of the personality. It includes a study of the individual; structures and functions of social groups, communities, and society; the antiquity, characteristics, and content of human culture as it influences individuals in society. It continues with an orderly presentation of some of the problems generated by accelerating social change, such as, technological unemployment, overpopulation, decline of rural society, the development of super-cities, and individual variances, such as crime, delinquency, mental illness, alcoholism, and the effects of inadequate or inappropriate environment. There is no single textbook suitable for this course.

Some suggested paperback readings, reprints from the *Scientific American* and other social science journals, and films containing pertinent subject matter are listed at the end of this outline.

Because the presentation is topical, it is recommended that quizzes be administered to evaluate the student's grasp of a topic before proceeding to the next one.

Major Divisions

		Class Hours
I.	Introduction to the Social Sciences	3
II.	Man	3
III.	Cultures of Man	3
IV.	The Individual	6
V.	Individuals in Groups	5
VI.	Societies	2
VII.	Social Organization	5
VIII.	Stratification of Society	4
IX.	Social Behavior Standards	3
X.	Communities	3
XI.	Problems of Individuals	3
XII.	Problems of Societies	5
XIII.	General Review	3
	Total	48

I. Introduction to the Social Sciences

Units of Instruction

1. Definition of subject matter
    a. Anthropology
    b. Sociology
    c. Psychology
    d. Psychiatry
    e. Relationship to history, economics, and political science
2. Definition of ideas
    a. Culture
    b. Society
    c. Personality
3. The acquisition of information
    a. Statistical information
    b. Human behavioral data
4. Meaning of new knowledge
    a. Consequences of recently formed concepts
    b. Film: *Saga of Western Man*

II. Man

Units of Instruction

1. Origins and descent

- a. Biological attributes of man
- b. Distinguishing characteristics
- c. Advantages

2. Races
    - a. Distribution
    - b. Compatibility
3. Social-cultural heritage
    - a. Antiquity of societies and human culture
    - b. Necessity of some social-cultural arrangements

III. Cultures of Man

Units of Instruction

1. Culture as a shared, learned behavior
    - a. Common to all members of society
    - b. Manner of transmission
    - c. How culture is learned
    - d. Culture is relatively changeless
2. Definition of ideas
    - a. Artifacts
    - b. Language
    - c. Value
    - d. Belief
    - e. Sanction
    - f. Norms
    - g. Others
3. Culture change
    - a. Means
        - (1) Innovation
        - (2) Diffusion
        - (3) Invention
    - b. Cultural lag
    - c. Variations of culture over time and space
    - d. Films on alien cultures conveying the idea of the integrity of other cultures as a basis for discussing our own
4. Culture and the individual

IV. The Individual

Units of Instruction

1. Behavior of people
    - a. Why they behave as they do
    - b. Personality inadequacy
    - c. Film: *Feelings of Rejection*
2. Personality development
    - a. Maturation
    - b. Socialization
    - c. The unconscious
    - d. Relationship of self and society
    - e. Role and status
    - f. Learning and growth
        - (1) Physically
        - (2) Mentally
        - (3) Films: *Learning and Behavior; Learning and Growth*
3. Deviancy—failure of the maturation process
4. Self-fulfilling prophecy

V. Individuals in Groups

Units of Instruction

1. Groups
    - a. Characteristics and functions
    - b. Primary and secondary
    - c. Limits on size and organization
2. Definitions of human aggregates
    - a. Crowd
    - b. Mob
3. Primary group
    - a. Shaping and supporting the individual
    - b. Film: *Men at Work*
4. Organization of groups
    - a. Authoritarian and democratic
    - b. For work
    - c. For recreation
    - d. Film: *An Experimentally-Produced Social Problem in Rats*

VI. Societies

Units of Instruction

1. Definition of society
2. Distinctions between society and culture
3. Examples of societies
4. Film: *Berber Country*

VII. Social Organization

Units of Instruction

1. Structure of societies
2. Discussion of the functions of institutions
    - a. Economic
    - b. Educational
    - c. Religious
    - d. Political-military
    - e. Recreational
    - f. Scientific
    - g. The family
3. A typical institution—kinds of social activity that are assignable to it
4. Function of the family in society
    - a. Procreation and socialization of the young
    - b. Basic identification for members
    - c. Approved sexual association for partners

    - d. Nuclear and extended families
    - e. Deficiencies in modern society
    - f. Film: *Angry Boy*
  - 5. Bureaucracy
    - a. Means of organizing industrial societies
    - b. Hierarchical structure
    - c. Characteristics and functions

- VIII. Stratification of Society
  - Units of Instruction
  - 1. Description of class structure
    - a. Social
    - b. Economic
  - 2. Minority groups
    - a. Ethnic distinctions
    - b. Racial distinctions
  - 3. Social mobility
    - a. Horizontal
    - b. Vertical
  - 4. Power Structure

- IX. Social Behavior Standards
  - Units of Instruction
  - 1. Conformity
  - 2. Formal and informal social controls
    - a. Folkways
    - b. Mores
  - 3. Normative and sanctions systems
  - 4. Deviations
    - a. Characteristic behavior
    - b. Probable causes
  - 5. Means of managing deviants
    - a. Courts
    - b. Hospitals
    - c. Prisons
    - d. Clinics
    - e. Supervision

- X. Communities
  - Units of Instruction
  - 1. Historic origins
  - 2. Characteristics and tendencies in growth
  - 3. Megalopolis
  - 4. Changing rural-urban population balance
  - 5. Obsolescence of cities and towns—causes and effects
    - a. Political
    - b. Economic
  - 6. Films: *Changing City; The Uprooted Nation*

- XI. Problems of Individuals
  - Units of Instruction
  - 1. Effects of inadequate preparation for:
    - a. Adult life
    - b. Community life
    - c. Unexpected experiences
      - (1) Technological unemployment
      - (2) Changes in life style
  - 2. Addictions and alcoholism
  - 3. Mental illness
    - a. Kinds
    - b. Implications
  - 4. Crime and delinquency
    - a. Antisocial and asocial behavior
    - b. Evaluating normality and abnormality
  - 5. Psychology and motivation of woodland fire setting
    - a. Social reasons
    - b. Criminal reasons
    - c. Biological reasons

- XII. Problems of Societies
  - Units of Instruction
  - 1. Modification and antiquity of culture
  - 2. Technological unemployment
    - a. Introductory film: *The Skilled Worker*
    - b. Beyond the control of the individual
    - c. Retraining for re-employment
      - (1) Age
      - (2) Sex
      - (3) Location of residence
  - 3. Chronic poverty and welfare
    - a. The impoverished way of life
    - b. Intentions vs. achievement of welfare programs
    - c. Problem of changing the culture of poverty
  - 4. Population
    - a. World population trends
    - b. Prospective food supply
    - c. Present problems in areas of major undernourishment
    - d. Future prospects in terms of
      - (1) Land use
      - (2) Communications
      - (3) Transportation
    - e. Birth control
  - 5. Wars
    - a. Implications of nuclear war for the future
    - b. Limited war—Viet Nam
  - 6. The affluent society

XIII. General Review

Units of Instruction

1. Review of main concepts taught in the course
2. Review of terminology
   a. Personality
   b. Culture
   c. Society
   d. Anthropology
   e. Psychology
   f. Sociology
   g. Behavior
   h. Rewards and punishment
   i. Groups
   j. Institutions
   k. Social classes
   l. Ethnic and racial minorities
   m. Social controls
3. Culture of man
   a. A creation of man to facilitate his living in society
   b. Most troubles of the world come from imperfect learning of it
   c. Accelerating social changes today

Texts and References

ADAMS. *The Origin of Cities.*

BETTELHEIM. *Individual and Mass Behavior in Extreme Situations.*

BUTTERFIELD. *The Scientific Revolution.*

DEEVEY. *The Human Population.*

DOBZHANSKY. *The Present Evolution of Man.*

HAWLEY. *Ecology and Human Ecology.*

LANDIS. *Current Perspectives on Social Problems.*

LEWIS. *The Culture of Poverty.*

MEAD. *The Social Self.*

MEISSNER. *Poverty in the Affluent Society.*

PALMER. *Understanding Other People.*

ROSE *and* ROSE. *Minority Problems.*

SAHLINS. *The Origin of Society.*

TAEUBER. *Residential Segregation.*

VIDICH *and* BENSMAN. *Small Town in Mass Society.*

WARD. *The Rich Nations and the Poor Nations.*

WARNER. *What Social Class Is in America.*

Visual Aids

Carousel Films, 1501 Broadway, Suite 1503, New York, N.Y. 10036.

Learning and Behavior. 16 minutes, 16 mm., black and white, sound.

Churchill Films, 662 North Robertson Boulevard, Los Angeles, Calif. 90069.

Berber Country. 16 minutes, 16 mm., black and white, sound.

The Changing City. 16 minutes, 16 mm., black and white, sound.

The Uprooted Nation. 22 minutes, 16 mm., black and white, sound.

Enyclopaedia Britannica Films, 1150 Wilmette Avenue, Wilmette, Ill. 60091.

Giant People (The Watussi). 11 minutes, 16 mm., black and white, sound.

Learning and Growth. 10 minutes, 16 mm., black and white, sound.

Indiana University, Audio-Visual Center, Bloomington, Ind. 47405.

Nervous System in Man. 18 minutes, 16 mm., color, sound.

International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Ill. 60604.

Angry Boy. 33 minutes, 16 mm., black and white, sound.

McGraw-Hill Book Company, Film-Textbook Division, 330 West 42nd Street, New York, N.Y. 10018.

Men at Work. 27 minutes, 16 mm., black and white, sound.

Saga of Western Man. 54 minutes, 16 mm., color, sound.

Superfluous People. 54 minutes, 16 mm., black and white, silent.

The Skilled Worker. 27 minutes, 16 mm., black and white, sound.

National Film Board of Canada, 680 5th Avenue, New York, N.Y. 10001.

Feelings of Rejection. 23 minutes, 16 mm., black and white, sound.

Psychological Cinema Register, Audio-Visual Aids Library, Pennsylvania State University, University Park, Pa. 16802.

An Experimentally-Produced Social Problem in Rats. 11 minutes, 16 mm., black and white, silent.

THE LIBRARY

Dynamic developments causing rapid changes in the technological sciences and practices make it imperative that the student of any technology learn to use the library.

In any evaluation of a technology teaching program, the qualifications of the librarian, the physical facilities, the quality, quantity, pertinency of content and organization of the library give a tangible indication of the strength of a program.

Instruction for the forest technology student should be library-oriented so that he learns the importance of knowing where he can find the information relative to any of the various courses which he is studying. He should learn how to use the library and should form the habit of using it as a tool in the learning process. This knowledge helps develop a professional attitude in the student and further teaches him to depend on libraries as a means of keeping abreast of the new developments in the field of forest technology.

Instructors of all courses should constantly keep the student aware of the extent to which a library contains useful information which can be helpful as a part of the study in his curriculum. Planned assignments of library projects calling for the student to go to the library and prepare information on persons and subjects in his courses enable him to understand the resources available and how they relate to forest technology. Open book examinations requiring the use of the library provide excellent and objective experience for the student as he works under the incentive of the examination and the limited time available.

The growth and success of the graduate forest technician will depend in large measure upon his ability to keep abreast of changes in his field. Libraries are information source agencies with trained personnel who classify resource data and assist those seeking it to find pertinent information quickly.

A central library under the direction of a professional librarian is important to the success of teaching technology curriculums. Most instructors have private libraries in their offices from which they may select books of special interest to discuss during personal conferences with students and thereby stimulate interest in related literature. However, a central library under the direction of a professional librarian insures the acquisition and cataloging of the library content according to accepted practice and provides the mechanics for locating reference materials by the use of systematic card files. The central library also provides the mechanics for lending books to students in a controlled and orderly manner typical of the libraries he will encounter in the course of solving problems in his employment after leaving school.

Study space with suitable lighting and freedom from distraction must be provided in the library for short-term study of reference data, and provisions for checking out reference materials should be systematic and efficient.

The well equipped, modern library should have some type of duplicating service. This service should be available to the students at minimum cost and free of personal cost to the staff.

The Library Staff and Budget

The head librarian usually reports to the dean or director of the school and has full faculty status.

The American Library Association standards state that, "Two professional librarians are the minimum number required for effective service in any junior college with an enrollment up to 500 students (full time equivalent). In addition there should be at least one non-professional staff member. The larger the more appropriate it will be to employ a higher proportion of non-professional staff members. Great care should be taken that professional staff members do not spend their time doing work that is essentially clerical because this is not only wasteful but also demoralizing."

According to the American Library Association, the library budget should be determined in relation to the total budget of the institution for educational and general purposes. The amount to be allocated to the library should be based on a program of optimum library service in support of the goals of the school. The execution of the library program, as it is outlined in these standards, normally requires a minimum of 5 percent of the total educational and general budget. This minimum percentage is for a well-established library with an adequate collection. It would have to be augmented if there were a rapid increase in the number of students or course offerings. It would also have to be increased if the library were responsible for an audio-visual program. The library budget for a newly organized institution should be considerably higher than 5 percent.

Another criterion for the library budget approved by the American Library Association is that the funds for acquiring new library materials should be equal to or exceed the cost of the total library staff. This is for established libraries. The expenditure for acquisition of new library materials should be substantially greater for libraries which are just starting or when major additions of curriculums are being made.

The Library Content

The library must provide the literature containing the knowledge encompassed by all subjects in the curriculum and extending somewhat beyond the degree of complexity or depth encountered in classroom activities. Literature dealing with unusually specialized aspects of a subject may be acquired as needed or may be borrowed by the librarian from more comprehensive libraries.

The library content should meet the needs of both full-time students and part-time students pursuing supplemental courses designed to upgrade or update their occupational knowledge and skills. In addition, it should serve the day-to-day needs of the instructional staff as it keeps its own technical knowledge abreast of new developments in its special field.

In view of the highly specialized nature of the library content for forest technology, it is recommended that the department head or chief instructor in the forest technology division be a member of a library committee and be responsible for finally approving the materials for forest technology and related courses. The librarian, as chairman of such a committee, may be expected to take the initiative in assisting the head of the department by keeping him informed of new literature and library materials which become available. The librarian should also take the initiative in calling a meeting or informally consulting the department head in order to acquire appropriate library content for the forest technology program within the limitations of the budget and the overall consideration of total library needs.

The library content may be classified into basic encyclopedic and reference index material; reference books pertinent to the technology; periodicals, journals, and pamphlets; a collection of books; and visual aids. Each will be discussed separately.

ENCYCLOPEDIC AND REFERENCE INDEX MATERIAL

This portion of the library content is basic in that it contains the broadly classified and organized cataloging of all available knowledge pertinent to the objectives served by the library and the program which it supports.

The following is a typical list of general reference material which might be found in a publicly controlled technical institute. Though many are general, all have some bearing on forest technology. It is suggested that some or all of these might appropriately be part of the library which supports a forest technology program. This list is not presented as being complete since there are other references and indexes which appropriately might support a forest technology program. It is presented as an example. It is suggested that upon ordering any of these references for a library collection, the latest edition be specified.

Guides to the Library

Cook, M. G. *The New Library Key.* New York: H. W. Wilson.

Gates, Jean Key. *Guide to the Use of Books and Libraries.* New York: McGraw-Hill Book Company, Inc.

Murphy, Robert W. *How and Where To Look It Up: A Guide to Standard Sources of Information.* New York: McGraw-Hill Book Company, Inc.

Russell, H. G., R. H. Shore, *and* B. E. Moen. *The Use of Books and Libraries.* Minneapolis: University of Minnesota Press.

Shores, Louis. *Basic Reference Books.* Chicago: American Library Association.

Winchell, G. M. *Guide to Reference Books.* Chicago: American Library Association.

Dictionaries

American College Dictionary. New York: Random House, Inc.

Chamber's Technical Dictionary. New York: The MacMillan Company.

Evans, Bergen *and Cornelia. A Dictionary of Contemporary American Usage.* New York: Random House, Inc.

Henderson, Isabella F. *and* W. D. *A Dictionary of Scientific Terms.* New York: D. Van Nostrand Company.

Roget's International Thesaurus. New York: Thomas Y. Crowell Company.

Webster's Dictionary of Synonyms. Springfield, Mass.: G. and C. Merriam Company.

Webster's Third New International Dictionary. Unabridged. Springfield, Mass.: G. and C. Merriam Company.

Encyclopedias

Columbia Encyclopedia. New York: Columbia University Press.

Encyclopaedia Britannica. Chicago: Encyclopaedia Britannica, Inc.

Encyclopedia Americana. New York: Americana Corporation.

Hutchinson's Technical and Scientific Encyclopedia. New York: The MacMillan Company.

McGraw-Hill Encyclopedia of Science and Technology. New York: McGraw-Hill Book Company, Inc.

Van Nostrand's Scientific Encyclopedia. New York: D. Van Nostrand Company.

Yearbooks

Americana Annual, 1924 to date. New York: Americana Corporation.

Britannica Book of the Year, 1938 to date. Chicago: Encyclopaedia Britannica, Inc.

McGraw-Hill Yearbook of Science and Technology. New York: McGraw-Hill Book Company, Inc.

New International Year Book, 1907 to date. New York: McGraw-Hill Book Company, Inc.

Indexes

Applied Science and Technology Index (formerly *Industrial Arts Index).* New York: H. W. Wilson Company.

Biological Abstracts. Philadelphia: Biological Abstracts, Inc.

Biological and Agricultural Index. New York: H. W. Wilson Company.

Book Review Digest. New York: H. W. Wilson Company, 1905 to date.

Essay and General Literature Index. New York: H. W. Wilson Company, 1934 to date.

New York Times Index. New York: The New York Times Company, 1913 to date.

Reader's Guide to Periodical Literature, 1900 to date. New York: H. W. Wilson Company.

Ulrich's International Periodicals Directory. New York: R. R. Bowker Company.

United States Government Publications: Monthly Catalog, 1895 to date. Washington: U.S. Government Printing Office.

Miscellaneous

Food and Agriculture Organization of the United Nations. *World Forest Products Statistics: 1946–1955.* Rome, Italy: The Organization, 1958.

Merrill, Anthony F. *Our Eastern Playgrounds.* New York: McGraw-Hill Book Company, Inc.

Society of American Foresters. *Forestry Handbook.* Washington: The Society.

TECHNICAL JOURNALS, PERIODICALS, TRADE MAGAZINES, AND PAMPHLETS

The importance of this portion of the library content has previously been emphasized. These publications represent the most authoritative, most recent, and most complete presentation of the knowledge and new application of principles to a specific area of applied science. It is essential that both instructors and students make frequent and systematic use of such literature to keep their technological information up to date. It is suggested that careful selectivity be exercised in retaining and binding or in microfilming these periodicals for permanent library use. Some represent important reference materials which may be used for many years. However, some—especially the trade journals—should not be bound for permanent reference because the really important material which they contain will usually become a part of a handbook or a text book or will be presented in a more compact or usable manner within a year or two.

The following is a typical list of technical journals, periodicals, and trade magazines which would be desirable in the library of a publicly controlled technical institute. Pamphlets published by forest experiment stations, universities, industrial organizations, and others are also an invaluable part of a library collection. This list is given as an example which may suggest appropriate publications to those who are concerned with this type of content for a library supporting a strong and well established forest technology teaching program. (Items marked • are suggested as being of first priority).

Advance Reports—National Fire Protection Association
•*American Forests*—American Forestry Association
American Nurseryman
•*American Tree Farmer and Forestry Digest*
•*A.P.A. Quarterly*—American Pulpwood Association
Appalachia—Appalachian Mountain Club
Arborists News—National Shade Tree Conference
Audubon—National Audubon Society
Bio-Science—American Institute of Biological Sciences
•*Canadian Forest Industries*
Chain Saw Age
Christmas Tree Growers Council Bulletin—Ohio Forestry Association
•*Conservation News*—National Wildlife Federation
•*Ecology*—Ecological Society of America
•*Field and Stream*
•*Fire Control Notes*—U.S. Forest Service, Department of Agriculture
•*Forest Chronicle*
•*Forest Farmer*—Forest Farmers Association Cooperative
•*Forest Industries* (formerly *The Timberman*)
•*Forest Practice Doings*
•*Forest Products Journal*—Forest Products Research Society
Forest Science—Society of American Foresters
•*Forestry Abstracts*—Commonwealth Forestry Bureau (England)
Greenthumb—Colorado Forestry and Horticulture Association
Grist—National Park Service, U.S. Department of the Interior
Hardwood Plywood Manual—Hardwood Plywood Manufacturer's Association
Journal of Economic Entomology—Entomological Society of America
Journal of Environmental Sciences—Institute of Environmental Sciences
•*Journal of Forestry*—Society of American Foresters
Journal of Mammalogy—American Society of Mammalogists
•*Journal of Range Management*—American Society of Range Management
•*Journal of Soil and Water Conservation*—Soil Conservation Society of America, Inc.
•*Journal of Wildlife Management*—Wildlife Society
Logger's World
•*National Geographic Magazine*—National Geographic Society
National Hardwood Magazine
National Parks Magazine—National Parks Association
•*National Wildlife*—National Wildlife Federation
Natural History
Newsletter—American Pulpwood Association
•*Northern Logger* (formerly *Northeastern Logger*)—Northeastern Loggers Association, Inc.
Our Public Lands—Bureau of Land Management, U.S. Department of the Interior
Outdoor America—Izaak Walton League of America
Outdoor News Bulletin—Wildlife Management Institute
•*Parks and Recreation*—National Recreation and Park Association
•*Photogrammetric Engineering*—American Society of Photogrammetry
Phytopathology—American Phytopathological Institute
Proceedings—Soil Science Society of America
Progressive Fish-Culturist—Fish and Wildlife Service, U.S. Department of the Interior
Pulp and Paper
Pulpwood Annual—American Pulpwood Association
•*Pulpwood Production and Sawmill Logging Recreation*
Soil Conservation—Soil Conservation Survey, U.S. Department of Agriculture
•*Southern Lumberman*
•*Sports Afield*
Surveying and Mapping—American Congress on Surveying and Mapping
Tappi—Technical Association of the Pulp and Paper Industry
The Consultant—Association of Consulting Foresters

The Nature Conservancy News—(The) Nature Conservancy

Transactions—American Fisheries Society

Transactions—Wildlife Management Institute

**Tree Planter's Notes*—U.S. Forest Service, Department of Agriculture

Trees Magazine

Wood Preserving News—American Wood Preservers Institute

Wood Research

Woodlands Review

*Various State, private, and Federal publications of a forestry and conservation nature (including numerous pamphlets).

THE BOOK COLLECTION

The American Library Association states that, "A 2-year institution of up to 1,000 students (full-time equivalent) cannot discharge its mission without a carefully selected collection of at least 20,000 volumes exclusive of duplicates and text books. Institutions with broad curriculum offerings will tend to have larger collections; an institute with a multiplicity of programs may need a minimum collection of two or three times the basic figure of 20,000 volumes. The book holdings should be increased as enrollment grows and the complexity and depth of course offering expands. Consultation with many junior college librarians indicates that for most, a convenient yardstick would be the following: 'The book stock should be enlarged by 5,000 volumes for every 500 students (full-time equivalent) beyond 1,000.' "

At the initiation of a forest technology program, it is recommended that the head of the forest technology program and the librarian review the current pertinent reference books available and select those to be placed in the library as regular reference material. The recommended policy is to place in the library only those reference books which are not a part of the regular text book material for the various courses.

It is suggested that at the beginning of a forest technology program, the library should contain at least 200 to 300 reference books on various aspects of forest technology and its related fields, particularly the field of professional forestry. Beyond the initial 200 to 300 books, there should be regular and systematic additions to the reference material in the library supporting the forest technology program from year to year, and eventually a weeding out of those references which have become obsolete.

A bibliography of textbooks on forestry, conservation, and natural resource management is available from the Society of American Foresters, Washington, D.C.

VISUAL AIDS

The same procedure is suggested for placing the visual aids content in the library as is outlined above for the acquisition of books pertinent to forest technology. Both the librarian and the head of the department should review and evaluate visual aid materials as they become available. Those which are deemed appropriate should be borrowed or rented for special use or purchased for regular use.

FACILITIES, EQUIPMENT, AND COSTS

Building and equipping adequate laboratories for teaching forest technology is expensive. Institutions undertaking such programs may find it necessary or desirable to spread the initial building and acquisition expenses of such laboratories over the first 2 years of the program. Ideally, such laboratories will be built and completely equipped before the first class of students is enrolled. Experience shows that if programs are started without adequate facilities and equipment, it is very difficult to convince the institution's administration that expenditures for more equipment are needed. A program should not be started without the necessary facilities and equipment to insure its success. Facilities should be planned so they may be expanded or modified to accommodate growth or change in the program.

Forest land area with a minimum of 2,000 acres within an hour's travel time is mandatory to provide valid forest education field exercises. The land might best be owned outright, but may be held by a long-term lease arrangement which assures its use for forest educational purposes. The building of roads, boundary surveys, cruising techniques, harvesting techniques, and other silvicultural functions cannot be taught on a theoretical, simulated basis. These activities must be performed by the students if practical learning is to occur. Maximum timber types, age classes, and topographic conditions must be included in this area.

No program should be considered if sufficient land area is not obtainable. These forest areas cannot be over-emphasized as they are the single most vital element in the creation of a new forest technology program.

General Planning of Facilities

It is assumed that the forest technology program will be added to an already existing educational institution and that buildings for ordinary classrooms, administration, library, and such general purposes already are available. Thus, only the specialized facilities are considered here.

Laboratories and related classrooms, offices, and storage facilities required for teaching forest technology do not present special or unusual conditions peculiar to the technology. Any well constructed building with suitable utilities may be used. However, if a building is to be constructed to house a forest technology program, planning should include maximum use of movable partitions and portable equipment to attain the greatest flexibility in the utility of space.

Consideration should be given to locating the forest technology machinery and equipment laboratory somewhat away from other educational facilities. Chain saws, tractors, and other machinery can cause noise interference with other school functions. If possible, the surveying equipment storage room should be on the ground floor where the dispatching of equipment and supplies for student use may be accomplished most efficiently. These suggestions are purely for convenience and in no way mandatory.

A classroom near the mensurational laboratory and drafting rooms is highly desirable. Classrooms and laboratories should be well lighted with a recommended minimum of 50-foot-candles of light at the table or desk top. Fluorescent lighting is satisfactory. However, it is suggested that in the drafting room a minimum of 70-foot-candles of light be required at desk level.

Single-phase, 110V electrical services should be provided for forest technology laboratories. Most equipment used in the laboratory requires only 110V. A 220V line should be extended to the repair shop.

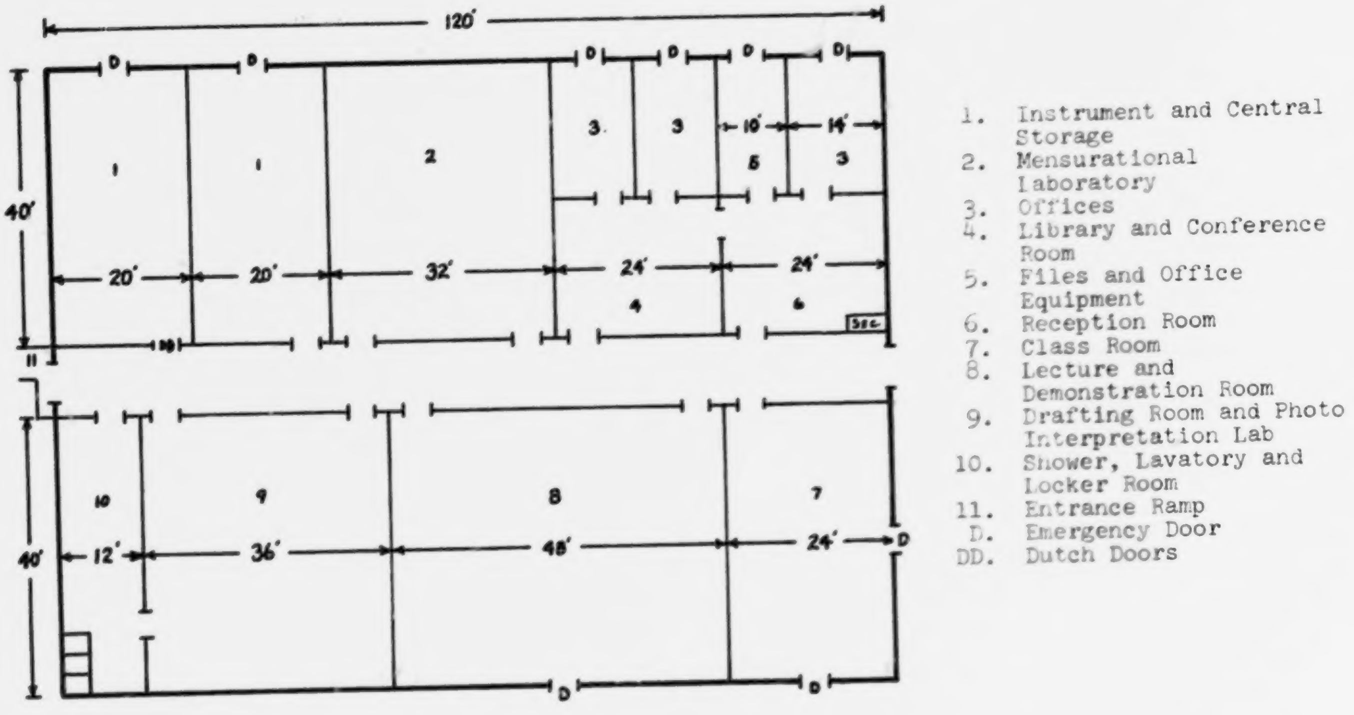
When planning space requirements for a forest technology department, many factors must be considered, such as: the number of students to be educated; the facilities already available; the number of staff members to be involved; and the length of the program. These factors and many others come into play before suggestions for area allotment can be made. The following discussion has been developed on the assumption that a 2-year program involving 45 beginning forest technology students, 30 advanced students, three instructors in the technical specialty courses, and a director or department head are to be accommodated. This assumes some laboratory and field exercises to involve 15 students, and thus requires scheduling of three laboratory sections for first-year students and two laboratory sections for advanced students. Students in excess of the number assumed may be accommodated by scheduling additional laboratory sections or by assigning more than three students to each laboratory group.

Figure 12 is an example of total floor space arrangement for a forest technology department. The access hall is centrally located to permit adequate classroom and laboratory areas on both sides. Through traffic is undesirable from both the security and the disturbance point of view; therefore, the hallway does not have a daily ingress-egress door at the far end. Compactness, of course, is desirable for convenience to students and staff.

There are many ways in which an area may be divided into classrooms, laboratory, and staff facilities. For the sake of flexibility, it is suggested that internal walls be movable partitions of steel and glass.

A floor plan should contain sufficient classroom space to conveniently accommodate the students within the department. Usually a single classroom is adequate. Normally the classroom will be equipped with student and instructor desks, chalk board, and a screen to be used with projection equipment. The rooms should be equipped to control the light to facilitate the use of visual aids. Electrical outlets for projection equipment must be provided.

Laboratory space is probably the most important area in a forest technology department. The laboratories must be planned for optimum convenience and utility for both students and instructors. Consequently, in-


120'
40'
40'
D
DD
1
1
2
3
3
5
3
4
6
10'
14'
20'
20'
32'
24'
24'
SSC
11
10
9
8
7
12'
36'
48'
24'
1. Instrument and Central Storage
2. Mensurational Laboratory
3. Offices
4. Library and Conference Room
5. Files and Office Equipment
6. Reception Room
7. Class Room
8. Lecture and Demonstration Room
9. Drafting Room and Photo Interpretation Lab
10. Shower, Lavatory and Locker Room
11. Entrance Ramp
D. Emergency Door
DD. Dutch Doors

SUGGESTED FLOOR PLAN FOR FORESTRY PROGRAM

FIGURE 12.—Suggested floor plan for forestry program.

dividual work benches equipped for single occupancy or teams of two students usually are to be preferred to long common benches for many students. Storage space for instruments and equipment should always be adjacent to or within the laboratory. Doorways should be located for easy traffic flow into and out of the laboratory. Storage areas in laboratories should be located so that the instructor can readily control the movement of stock, instruments, and materials. Laboratories should be equipped with a chalk board and a screen for projection equipment. Certain laboratories will have multiple use and may even double as classrooms for teaching other subjects. (See Figures 13, 14, and 15).

The floor plan of a forest technology department's facilities suggested in Figure 12 has been considered from cost and practical teaching points of view.

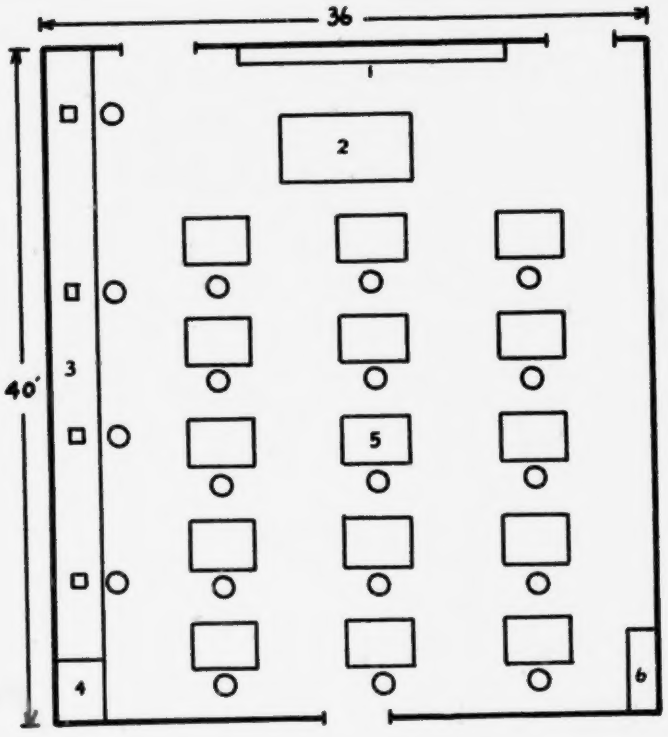
It is a simple, one-floor arrangement isolated in a separate building or separate wing of a building. It is compact, functional, and arranged so utility installation costs may be kept to a minimum, with a minimum of service lines hidden in partitions or located in inaccessible areas.

The reception room and offices for the staff, a classroom, and a lecture-demonstration room are located in one end of the building, as much removed as possible from the two main forestry laboratories (drafting and mensurational). This tends to avoid student traffic through the laboratory area and is a convenient arrangement for the instructional staff. (See Figure 12).

A central storeroom is used primarily to provide materials to the mensurational and surveying laboratory; hence, is located as centrally to them as possible. This makes it possible for students to obtain storeroom service only a few feet from the laboratory in which they are working and makes it easy for instructors to check with the storeroom supervisor without going far from their laboratory class.

The reserve storeroom is located as close to the outside door as possible. The reserve storeroom is planned not only as a receiving area, but also as an area where quantity lots of material can be stored until needed.

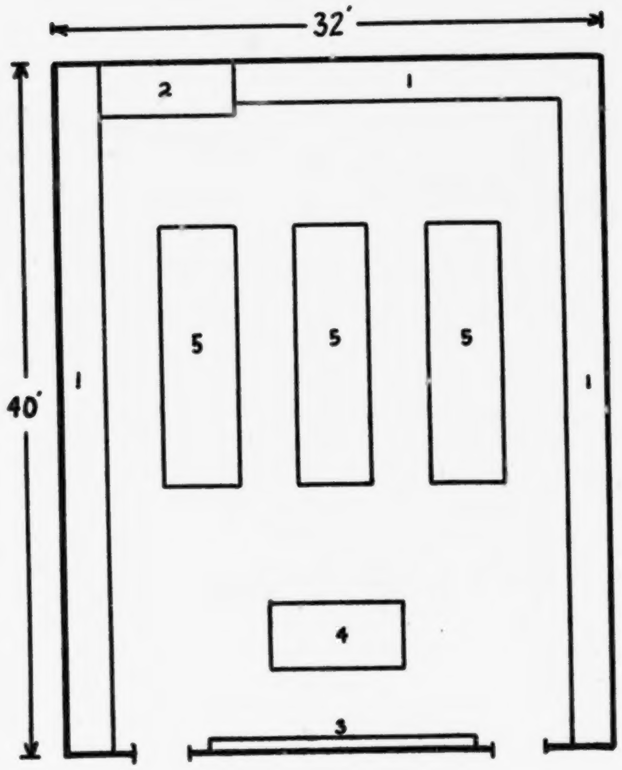
The lecture-demonstration room is located relatively near the central storeroom because most of the demonstrations will require apparatus and materials from the storeroom. Demonstration models, mock-ups, and other


36
40'
1
2
3
4
5
6
DRAFTING & PHOTO INTERPRETATION LABORATORY

1. Blackboard & Corkboard
2. Demonstration Table 4' x 8'
3. Calculator Bench 36' x 3'
4. Storage Locker 3' x 4'
5. Tilting Drafting Table (3' x 4') with flexible arm fluorescent light
6. Instrument Cabinet

D. Emergency Door

FIGURE 13.—Drafting and photo interpretation laboratory.


32'
40'
1
2
3
4
5
GENERAL MENSURATION & SURVEYING LABORATORY

1. 2.5' Electrified Wall Tables for desk calculators
2. Storage Cabinet 3' x 8'
3. Chalkboard
4. 4' x 8' Demonstration Table
5. Center Tables 4.6' x 15' with electrical hook-up

FIGURE 14.—General measuration and surveying laboratory.

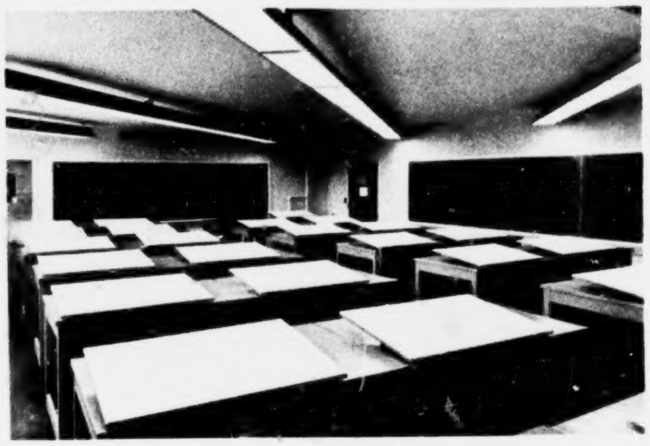


FIGURE 15.—Well equipped and well lighted facilities such as this drafting room are essential to a high quality forest technician education program.

materials can be stored in the central storeroom and thus be easily available for lecture room use.

While storage space is suggested here, more might well be planned and provided for because it seems to be impossible ever to have sufficient.

SAFETY

Planned safety for forestry teaching facilities costs very little. Some safety suggestions which should be considered in designing a forestry laboratory area follow:

Every laboratory should have at least *two exits* and two alternate routes for evacuation. If a work area should catch fire due to inflammable materials, it is possible that the fire can be shut off at one exit; thus, two exits are an absolute must for all forestry work areas.

Fire extinguishers should be installed and made easily available in all forestry laboratory areas.

Fire extinguisher types and locations should be planned when the building is designed, and extinguishers should be placed where a man in any room can reach a fire extinguisher and make his way out of the fire and room.

Safety glasses should be worn by everyone working in mechanical laboratories. It is an almost universal practice in most laboratories to require technicians and other personnel to wear safety glasses at all times. Safety regulations at a school laboratory should require all students who take a course in forestry or mechanics to purchase a set of safety glasses and to wear them at all times when they are in the laboratory.

Safety regulations should be posted in each laboratory and should be specifically called to the attention of all students and workers at the beginning of the work day. Most accidents, in both indoor and outdoor laboratories, are caused by lack of attention to safety precautions, "horseplay," or some other unnecessary act. Forestry personnel must constantly be aware of and practice safety precautions.

Field exercises in silviculture require all students to purchase and wear light-steel leg guards and hard hats. Logging field work requires all students to purchase and wear hard hats and safety knee patches (fibre-glass). Hard hats should be required personal equipment in all field exercises and can be adorned with insignia representing the school. This practice will frequently increase the "esprit de corps" of the unit.

Telephone facilities should be carefully planned. Extensions to such areas as machine shops and storage areas where instructors may be busy may save time for both instructors and those with whom they work.

In the following discussion, the diagrams are intended to show suggested equipment and arrangement of space for laboratories, storerooms, and offices, and are not intended to be complete. Such items as janitors' closets and students' and staff toilet facilities, for example, are not shown, but must be provided in a complete plan of facilities for teaching forestry.

CENTRAL AND RESERVE STOREROOMS

It is desirable to have the central storeroom located as near to all laboratories as possible to reduce the distance and time required to reach the storeroom. (See Figure 12.) In addition, a reserve storeroom is recommended in which to store extra material. This allows material to be moved to the central storeroom for distribution to various laboratories as needed. The reserve storeroom should be located near the unloading ramp or outside door.

MACHINERY AND EQUIPMENT REPAIR

Attached to the main building should be a repair facility for the care and minor repair of trucks, tractors, and other machinery. This building should be equipped with a floor jack, air compressor, welder, oxy-acetylene unit, and various mechanics' hand tools. (See Figure 16.)

GASOLINE AND CHEMICAL STORAGE

A gasoline and chemical storage facility must be made available in a small (10′ x 25′) cinder or cement block building near to but not attached to the main building. This storage shed should contain a 250-gallon gasoline tank with pump and hose, and shelves for the storage of chemicals. (See Figure 17.)

TRANSPORTATION EQUIPMENT STORAGE

A pole-type shed or other suitable shelter should be erected to protect trucks and other rolling stock from adverse weather conditions. This shed may easily be covered with aluminum roof sheathing which is relatively inexpensive but quite serviceable. The style of the shed should complement the main building so it will not detract from the overall esthetic values of the campus.

WOOD UTILIZATION LABORATORY (Sawmill)

Some programs have enough timber to justify a small sawmill. Others may lease time in a small mill for the purpose of log dissection and related instruction. It is not "required" equipment but is desirable for providing the dissection and other experience so important to forest technicians. If not owned, some arrangement such as rental or leased time in a small mill serve the purpose. The combined facilities of a building and lumber yard can serve as an outdoor laboratory where instruction may be given in several different subject areas. The building itself can house sawing and other equipment to reduce logs to lumber. Logs can be stored on the log deck for log grading.

OFFICE SPACE FOR STAFF

Suggested office space for staff is indicated on the schematic diagram (See Figure 12) for the forest technology department.

Office space should be provided for each instructor, and it is recommended that no more than two staff members be located in any one office. More than two staff members occupying an office tend to discourage students from approaching instructors for assistance. It is desirable to have a waiting room adjacent to staff offices where students can study comfortably while waiting for the in-

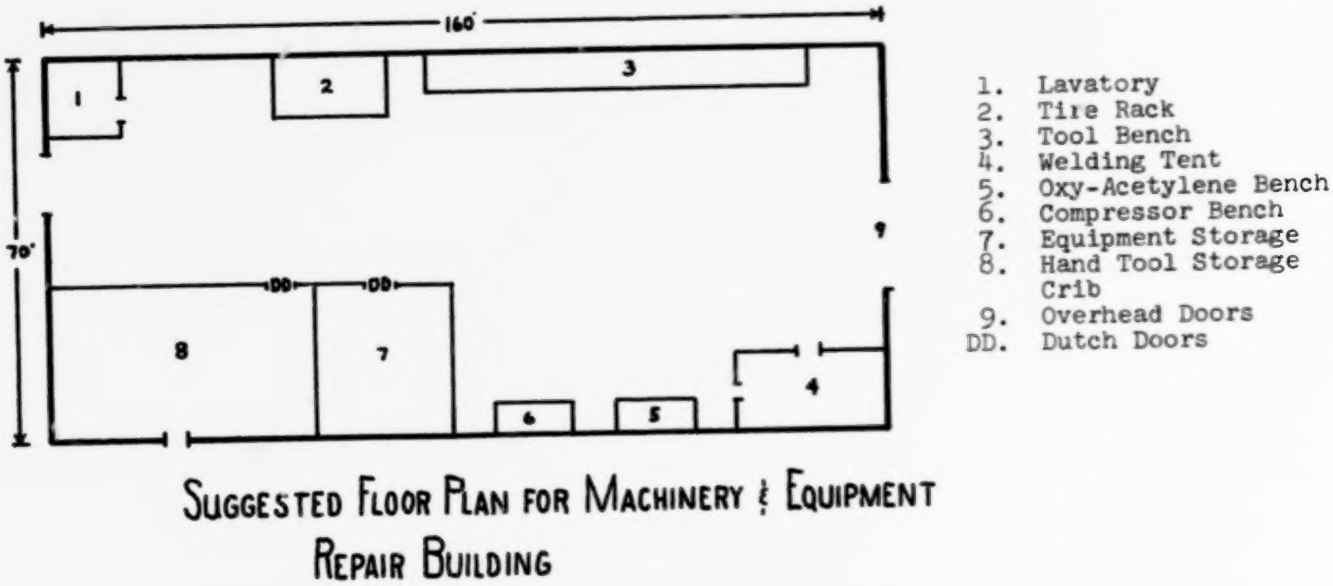
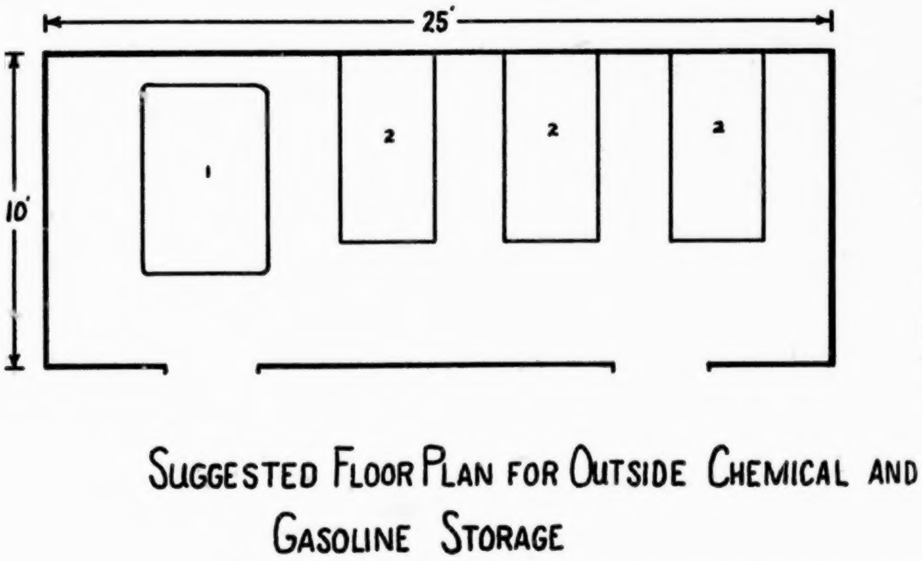


FIGURE 16.—Suggested Floor Plan for Machinery and Equipment Repair Building.


25'
10'
1
2
2
2
SUGGESTED FLOOR PLAN FOR OUTSIDE CHEMICAL AND GASOLINE STORAGE

1. Gasoline storage tank 6' x 4' with extra length reel type hose for outside use
2. 3' x 6' adjustable storage shelves

Building is 15' high with a back sloping roof. A metal edge along the back of roof eliminates snow and ice build-up

FIGURE 17.—Suggested Floor Plan for Outside Chemical and Gasoline Storage.

structor's assistance. Usually, the waiting room will house the departmental secretary who can arrange conference appointments for students if necessary.

The conference room shown in Figure 12 may also be used for student and staff conferences. No specialized equipment is needed for forest technology department staff offices.

A small room should be made available for the storage of alumni files and the operation of office machines.

DEMONSTRATION AND LECTURE ROOM

Seats in the demonstration-lecture room should be so arranged that the view of the demonstration tables is good from both the rear and the front of the room. Sloping seats have been found to be a good arrangement, although the sloping floor tends to reduce the flexibility of the use of the space. The room should be equipped with a lecture-demonstration table and should have electrical outlets.

The demonstration room should be located near the stock room. This allows the technician who operates the stock room to prepare visual aids and demonstration materials and to deliver them expediently to the teacher in the demonstration room. No attempt should be made to stock demonstration apparatus and supplies in the lecutre room. They should be delivered from the stock room whenever needed.

The Cost of Equipping the Laboratories

The following estimates of the costs of completely supplying and equipping an ideal but not an extravagant forest technology department for teaching technicians reflect 1968 costs.

The estimates are based upon the acquisition of modern equipment and supplies of good quality, but not the most expensive.

The estimates assume the availability of a building of suitable construction, equipped with normal services such as electricity, heat, and water to and from the building, but otherwise unfurnished.

No provision is made in this estimate for office furniture, conventional classroom blackboards, student seats, filing cabinets, and the conventional staff or instructors' office equipment.

The estimates are for well equipped laboratories having the furnishings and equipment described in the diagrams and listed hereunder for each facility. These facilities may be considered typical of those required for a good forest technician education program. Facilities for any given institution may be expected to vary in detail, but should include most of the facilities and equipment herein described.

The specifications for laboratory equipment listed in this section are typical of equipment to be used in teaching forest technicians. Quantities suggested are intended for a class of 10-15 students per section for technical specialty courses under optimum instructional conditions.

When a program gets under way and all the recommended equipment has been purchased, it will still be necessary to have an annual equipment and supply budget. These funds are required to replace or repair equipment, to re-stock expendable items, and to purchase new equipment to meet regional modifications of the program. At least $7,000 to $10,000 per year should be planned to meet such needs and substantially more may be required if special new types of equipment are developed and needed to keep the program up to date.

The laboratory benches and other units shown in the diagrams and drawings are representative of those available from several equipment suppliers. When a forestry program is being planned in detail, it is suggested that the engineering services of such suppliers be obtained. Suppliers will generally provide complete drawings and specifications for an entire laboratory layout in such form that they may be used to obtain competitive bids. Such engineering services generally are provided free of charge, and the suppliers' experienced engineers provide alternate plans and detailed suggestions which promote efficient arrangement and economical use of space and funds for the facility.

While most of the basic laboratory work benches, cabinets, and other units can be built on the spot, it is not generally recommended. In most instances the standard unitized equipment available from laboratory equipment suppliers is well engineered, efficient in service, and probably most economical if purchased and installed under contract.

In initiating any forestry program, individuals planning the facilities and purchasing the laboratory equipment should consider what, if any, equipment is already available at the institution. Joint use of some of the forestry equipment may be feasible and prevent duplication of expensive equipment.

However, joint use of apparatus and equipment requires carefully coordinated planning with the other departments since it is essential that each department have sufficient equipment for its own needs when it is needed. Careful planning is also required to accommodate the shared responsibility for the use of the facilities and equipment.

The department head or instructor should make the final decisions on the choice of laboratory equipment because of his knowledge of technical details. The instructor can avoid costly mistakes which often result if non-technical personnel attempt to equip a forestry laboratory.

Surplus equipment from either private or public organizations can be an important source of good materials and hardware for equipping forestry laboratories. Government surplus property may often be an especially attractive source of either standard or specialized components, units, assemblies, mechanisms, instruments, and systems at a price which is usually only a small fraction of their new cost. Educational institutions are high on the priority list of agencies to which Government surplus property is made available.[1]

Distribution of surplus property within the States must be made through the State agency for surplus property. Most State agencies maintain one or more distribution centers at which authorized representatives of eligible schools or school systems may select materials for educational use. Usually one or more officials of the school or school system are designated as authorized representatives. Technical educators should communicate with their authorized school system representative, if one exists, to arrange to visit their State agency's distribution center, or write to the director of the State agency for surplus property to obtain information regarding the procedures to be followed in acquiring equipment.

The State Director of Vocational and Technical Education can provide specific information on the location of the Government surplus property distributing agency in his State and the person in charge. Information on Government surplus property may also be obtained by writing to: Chief, Division of Surplus Property Utilization, U.S. Department of Health, Education, and Welfare, Washington, D.C. 20201.

Experience has shown that it is even more important to exercise judgment and care in acquiring surplus equipment than in buying new equipment. Specific plans for the use and sound justification for the need should clearly be established for any piece of surplus equipment. A careful analysis should be made of its total effectiveness in the program; its space requirements; its full cost, including initial outlay and charges for transportation, installation, repair or tune-up (if incomplete), and maintenance; and its pertinence in terms of obsolescence.

Only technically competent, responsible, and imaginative persons should select surplus equipment, and then only after a thorough on-site inspection. This practice avoids the temptation or tendency to acquire attractive but obsolete, inappropriate, bulky, or excessive amounts of equipment.

Granted the foregoing approach, the resourceful department head or instructor can usually obtain machinery, materials, instruments, apparatus, or other essential up-to-date equipment for field or laboratory teaching at very reasonable expense.

The cost of establishing, equipping, and operating a department for teaching forest technicians will vary somewhat depending upon its distance from major suppliers, the size of the department, the quality of equipment or supplies purchased at any given time, and the method of purchase. If the equipment can be bought as a part of a large purchase of scientific equipment or machinery through a central purchasing agency, the total price may be somewhat less than if the items are purchased separately.

When plans to establish, enlarge, or reequip a forest technology department progress to a point which requires a detailed and precise estimate of cost, it is suggested that the services of major suppliers be obtained so that the estimates may be complete and sufficiently accurate for current budgetary purposes. *The purchase of up-to-date equipment of good quality is the best preparation for a successful program for forest technicians.* Two types of suppliers probably will be involved in establishing or refurnishing a forest technology program.

One type is the manufacturer and supplier of the major units of permanently installed equipment for forest technology laboratories, such as unitized work tables and specialized storage cabinets. Generally these are supplied by the manufacturer and may best be purchased under a contract both to supply and install the equipment.

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[1] U.S. Department of Health, Education, and Welfare. Office of Field Administration. Division of Surplus Property Utilization.

Directory: Directors of State Agencies for Surplus Property and Regional Representatives, Division of Surplus Property Utilization, Department of Health, Education, and Welfare. Washington: U.S. Government Printing Office, 1965.

How To Acquire Federal Surplus Personal Property for Health, Education, and Civil Defense Purposes and Federal Surplus Real Property for Health and Educational Purposes. Washington: U.S. Government Printing Office, 1965.

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The second type of supplier sells specialized machinery or equipment, such as clinometers, compasses, logging supplies, tractors, surveying equipment, chain saws, and similar equipment.

Both types of suppliers may be found in *Thomas's Register* or in any other comprehensive listing of suppliers of equipment or machinery.

Leasing of some items of equipment should be explored thoroughly early in the planning to equip a forest technology program. Some of the machinery can usually be leased for the period needed for minimal instruction in function and use. The costs which follow are based on purchase of the equipment.

LECTURE-DEMONSTRATION ROOM

Item	*Number*
Demonstration Table	1
Projection Equipment	
16-mm. Projector with Screen	1
Opaque Projector	1
Overhead Projector	1
Slide Projector (Carousel type)	1
Tape Recorder	1
35-mm. Camera and attachments	1
Polaroid Land Camera	1
Ditto Machine	
Total Estimated Cost	$3,500–$4,500.00

GENERAL EQUIPMENT AND SUPPLIES REQUIRED TO OPERATE THE PROGRAM

Most of the following equipment can be used year around if a crew of two to three men are hired to do woods work including road building, logging, and grounds maintenance.

The sawmill is included here since it is utilized as both a production and teaching unit in Mensuration, Logging, and Wood Utilization.

Equipment

Item	*Number*
Staff Station Wagon	1
4-wheel-drive, ¾-ton Pickup with long body (personnel)	1
Canopy Truck (Personnel), 1½ ton	1
3-cu.-yard Dump Truck, 2 speed rear axle, 5-yard head and tailbound	1
Road Rake	1
JD 2010 Crawler or equivalent with 4-angle dozer blade, integral arch, winch, and canopy	1
Farm Tractor with integral bucket and log forks	1
3-ton, stake body, Dump Truck	1
Bus, 44 passenger, heavy duty	1
6-ton, high-wheeled, pneumatic tired Fork Lift, high-centered, 9-foot mast	1
Stationary electric circular (52") Sawmill with edger, cut off, and double end trimmer. A durable building is included to house the saw and equipment.	1
Desk Calculators	10
Chain Saws	6
Filing Guides, clamp-type	2
Peavys, short-handled	6
Peavys, long-handled	4
Logging Boom	1
Rubber-tired Skidder	1
Scoots	2
5-ton Log Truck with hydraulic loader	1

Supplies

Item	*Number*
Gasoline Cans, 2½ gal., red	5
Oil Cans, 1 gal.	5
Felling Wedges, magnesium	10
Filing Guides, hand, with file	6
Cable Chokers, ⅛", 2 slip hooks, 6-ft. length	6
Logging Tongs	2 pr.
Flat Bastard Files	6
Tool Kits, small	6
Markal Paint Sticks	3 doz.
Log Rules, ½" Int.	6
Polyhooks	6
Load Binders, heavy duty	4
Log Chain	150 ft.
Total estimated cost, Equipment and Supplies	$140,000 to $185,000

GENERAL DRAFTING LABORATORY

A representative list of apparatus for the general drafting laboratory along with a cost estimate of the contents follows. (This laboratory can also be used for courses in Surveying and Photo-Interpretation.)

Equipment

Item	*Number*
Drafting Tables, 3' x 4', metal base, dust cover (tilting top)	15
Drafting Tables, 3' x 5', metal base, dust cover (tilting top)	15
Drafting Stools	30

Reproduction Machine	1
Filing Cabinets for instructors	2
Map File Cabinets, five drawers with base and cap, 30" x 42"	2
Drawing Instruments	15 sets
Limited number of auxiliary items such as beam compasses	
Demonstration Slide Rule, 7'	1
Assorted Slide Rules to demonstrate types used in industry	10
Flat Scales, assorted	30
Triangles	30 sets
Assorted Curves and Templates	2 sets
Cutting Board	1
Lettering Guide Sets	4
12" Trimming Shears	5

Supplies

Tracing paper, drawing paper, tracing cloth, reproduction paper and supplies, assorted graph paper, orthographic, isometric, and oblique sketching paper and pads, coordinate sheets, lettering guide sheets, pencils, erasers, erasing shields, thumb tacks, masking tape, ink, and other

Total estimated cost,
Equipment and Supplies $10,000 to $12,000

ELEMENTARY SURVEYING LABORATORY

Item	*Number*
Steel Tapes, 100' Surveyor's	15
Plumb Bobs, 8-ounce	15
Steel Tapes, 2-Chain, Topographic	15
Compasses, Staff with Tripods	12
Chaining Pins	12 sets
Abney Levels	12
Clinometers	12
Range Poles	20
Polar Planimeters	10
Grids	
Total estimated cost	$4,500 to $6,000

ADVANCED FOREST SURVEYING

Item	*Number*
Transits	6
Levels	6
Plane Tables and Alidades	6
Level Rods	6
Stadia Rods	6
Engineer's Tapes	6
Chaining Pins	6 sets
Total estimated cost	$9,000 to $11,000

PHOTO-INTERPRETATION LABORATORY

A representative list of apparatus required for the photo-interpretation laboratory follows: (If scheduling permits, this laboratory can also be used as the drafting laboratory).

Item	*Number*
Carousel-type Projector—Remote-controlled with screen	1
Tape Recorder	1
Stereo Plotters	4
Vertical Sketchmasters	3
Mirror Stereoscopes (Government surplus suggested)	10
Parallax Bars (Government surplus suggested)	15
Lens-type Stereoscopes (pocket, folding)	20
Height Finders (Parallax Bars to fit Stereoscopes)	20
Stereocomparagraphs	4
100' Surveyor's Steel Tapes	10
USGS Topographic Maps of 1:24000 Scale (local area)	30
Sets of three Photos, 9" x 9" with 60% forward overlap (Expendable—new photos will be required for each class)	30
Shadow Scale Guides, Crown Density Guides, Protractors	20 sets
Drawing Tables with Stools (See drafting equipment)	15 sets
Flexible Arm Fluorescent Lights (Individual)	15
Total estimated cost	$5,000 to $6,000

FOREST MENSURATION LABORATORY

A representative list of apparatus for the forest mensurational laboratory follows:

Item	*Number*
Surveying Compasses, complete	5
Tree Marking Guns	5
Tally Meters	15
Tree Calipers	15
Bark Gauges	15
Diameter Tapes	15
Abney Levels	10
Increment Borers with Case	15
Loggers' Tapes	10
Polar Planimeters	10
Topographic Trailer Tapes	10
100' Steel Tapes	15
Biltmore Sticks	15
Log Rules	30
Haga Altimeters	5
Relaskops	4
Syracuse Tree Markers	10
Supply items such as tree marking paint, tree marking chalk, assorted flagging, aluminum tags, felt tip markers	
Total estimated cost	$5,500 to $7,000

APPLIED SILVICULTURE FIELD EQUIPMENT AND SUPPLIES

Item	*Number*
Mistblower	1
Pruning Saws with blades	15
Pruning Saws, hand	15
Paint (Marking) Guns	9
Tree Markers	15
Tree Injectors	2
Pressure Spray Cans (3-gal. cap.)	2
Brush Saw	1
Woodsman's Saws	8
Brush Axes	8
Direct Seeders	8
Planting Bars	15
Planting Mattocks	15
Miscellaneous supplies (paint, flagging tape, planting bags, oil cans, and such items)	
Total estimated cost	$2,500 to $3,500

INITIAL SUPPLIES AND SPECIAL FACILITY FUNDS ALLOWANCE

The foregoing lists of equipment do not include student equipment and supplies which may or may not be supplied by the institution. Aluminum safety hats required for field operations, axes (limbing, hand, and standard woods sizes), leg guards, and safety knee patches are examples of items which usually will be supplied by the institution. These and other items required by students may cost from $35 to $75 per student depending on what is supplied by the school.

The foregoing cost estimates also do not make allowance for special equipment or apparatus which may be required for a new program and which may differ in some way from the program outlined in this publication. It is therefore recommended that from *$10,000 to $15,000* of funds be allowed to cover initial supplies and special facilities required by any new program.

The foregoing estimates and suggested provisions for funds do not include a yearly operating, maintenance, and supply budget which has been discussed earlier in this section, nor do they provide for salaries of any of the personnel required for the program.

Summary of Costs

The equipment listed is basic and does not include items for specialized programs. The cost estimates assume the purchase of new equipment of good quality in the quantities indicated. Especially advantageous buying and the acquisition of suitable government or private surplus equipment may make it possible to equip forest technology field laboratories at less cost. For the purposes of estimating the probable costs of equipping a forest technology program, these cost reduction potentials *should not be counted on.*

Therefore, the total cost of equipping a forest technology program based on 1968 prices may be estimated as follows:

Lecture-demonstration room	$3,500 to	$4,500
General equipment and supplies required to operate the program	140,000 to	185,000
General drafting laboratory	10,000 to	12,000
Elementary surveying laboratory	4,500 to	6,000
Advanced forest surveying	9,000 to	11,000
Photo-interpretation laboratory	5,000 to	6,000
Forest mensurational laboratory	$5,500 to	$7,000
Applied silviculture field equipment and supplies	2,500 to	3,500
Initial supplies and special facility funds allowance	10,000 to	15,000
TOTAL ESTIMATED COST TO FULLY EQUIP THE PROGRAM	$190,000 to	$250,000

The foregoing estimates do not provide for the cost of the buildings which, if constructed for the program, may be calculated at $14 to $16 per square foot of unfurnished laboratory space. Such space with special utilities and built-in furnishing, without portable equipment, may be estimated at $30 to $35 per square foot.

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APPENDIX

Selected List of Organizations and Associations Pertinent to the Education of Forest Technicians

A list of some of the professional, scientific, and technical organizations and associations concerned with forest technology and its application may be a useful source of instructional information and reference data.

The selected list which follows is not a complete listing of all such organizations, and inclusion does not imply special approval of an organization, nor does omission imply disapproval of an organization. Details regarding local chapters or sections of societies have been omitted.

It is suggested that teachers and others desiring information from the organizations listed below should address their inquiry to "The Executive Secretary" of the organization.

AMERICAN CONGRESS ON SURVEYING AND MAPPING, 733 15th Street, NW., Washington, D.C. 20005.

History: Organized June 1941.

Purpose: To advance the science of surveying and mapping in its several branches, to further the interests of both those who use maps and surveys and those who make them, to contribute to public education in the use of maps and surveys, to encourage the prosecution of basic mapping and surveying programs which are paid in whole or in part with public funds; and to provide means or channels for the exchange of information, advancement of techniques, and establishment of standards in the professional and public interest.

Total Membership: 6,000

Publications: *Surveying and Mapping*, quarterly; *ACSM Bulletin*, periodically.

AMERICAN FISHERIES SOCIETY, 1404 New York Avenue, NW., Washington, D.C. 20005.

History: Organized 1870; incorporated in the District of Columbia, 1910.

Purpose: To promote conservation, development, and wise utilization of fisheries, both recreational and commercial.

Total Membership: 2,100

Publications: *Transactions*, quarterly.

AMERICAN FORESTRY ASSOCIATION, 919 17th Street, NW., Washington, D.C. 20006.

History: Organized April 1882, in Cinncinnati, as the American Forestry Congress; joined at the Montreal meeting, August 1882, by an earlier American Forestry Association organized in Chicago in 1875; name changed to present title 1889; incorporated, January 1920, in the District of Columbia.

Purpose: To promote the advancement of intelligent management and use of the country's forests and related resources of soil, water, wildlife, and outdoor recreation.

Total Membership: 40,000

Publication: *American Forests*, monthly.

AMERICAN FOREST PRODUCTS INDUSTRIES, 1816 N. Street, NW., Washington, D.C.

History: Founded 1941.

Purpose: To promote improved forest management on private lands.

Total Membership: 1,000

Publications: *Forestry Digest*, monthly; *American Tree Farmer*, monthly; *Convention/Meeting*, annual.

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

History: Organized February 1948; incorporated January 1955.

Purpose: To advance the biological, medical, and agricultural sciences and their applications to human welfare; to give assistance to societies, organizations, and individual biologists in matters of common concern which can be most effectively dealt with by united action.

Total Membership: 15,000 (43 adherent societies and 17 industrial members)

Publications: *Bio-Science*, monthly; *Quarterly Review of Biology*.

AMERICAN PULPWOOD ASSOCIATION, 605 Third Avenue, New York, N.Y. 10016.

History: Organized January 30, 1934.

Purpose: To guide and help the pulpwood industry grow and harvest pulpwood of the highest quality and in sufficient amounts now and for future generations, at a reasonable cost; to serve the entire industry in technical safety and training, statistics, forest management, and legislative programs; to encourage all members to prepare now for the predicted increase in pulpwood consumption.

Publications: *A.P.A. Quarterly; Newsletter*, weekly; *Pulpwood Annual*.

AMERICAN SOCIETY OF PHOTOGRAMMETRY, 644 Leesburg Pike, Falls Church, Va. 22044.

History: Organized August 1934; incorporated October 1934.

Purpose: To advance knowledge in the science and art of photogrammetry; to provide means for the dissemination of new knowledge and information, and thus to encourage the free exchange of ideas and intercourse among those contributing to the advancement of the art; to stimulate student interest in the field of photogrammetry by advocating a strengthening of college curriculums; to hold meetings for the presentation of symposia, panels, papers, and discussions; and to exert its efforts toward the improvement of standards.

Total Membership: 4,000

Publications: *Photogrammetric Engineering,* semimonthly. *Manual of Photogrammetry* (textbook); *Manual of Photographic Interpretation* (textbook).

AMERICAN SOCIETY OF RANGE MANAGEMENT, P.O. Box 5041, Portland, Oreg. 97213.

History: Organized 1947; incorporated in the State of Wyoming, June 1949.

Purpose: To advance the science and art of grazing and management, to promote progress in the conservation and greatest sustained use of forage and soil resources, to stimulate discussion and understanding of scientific and practical range management problems, to provide a medium of exchange for ideas and facts among Society members and with allied technicians, and to encourage professional improvement of members.

Total Membership: 4,585

Publications: *Journal of Range Management,* bimonthly.

ASSOCIATION OF CONSULTING FORESTERS, Box 6, Wake, Va. 23176.

History: Organized and incorporated in 1948.

Purpose: To assure forest owners of competent professional service through maintenance of high standards of performance by consulting foresters; to promote the most economical and most scientific management of forest resources.

Total Membership: 150

Publications: *The Consultant,* quarterly.

ECOLOGICAL SOCIETY OF AMERICA, Oak Ridge National Laboratory, Radiation Ecology Division, Oak Ridge, Tenn. 37831.

History: Founded 1951; incorporated 1957; a member of American Institute of Biological Sciences since 1957.

Purpose: To promote the scientific study of organisms in relation to their environment, both as individuals and as members of populations and communities; and to facilitate the exchange of ideas among those interested in this area of study.

Total Membership: 2,850

Publications: *Bulletin,* quarterly; *Ecology,* quarterly; *Ecological Monographs,* quarterly.

ENTOMOLOGICAL SOCIETY OF AMERICA, 4603 Calver Road, College Park, Md. 20740.

History: Founded in 1953 by a merger of the American Association of Economic Entomologists, organized 1889, and the former Entomological Society of America, organized 1906.

Purpose: To promote the science of entomology in all its branches and to assure cooperation in all measures tending to that end.

Total Membership: 4,950

Publications: *Journal of Economic Entomology,* six times a year; *Annals,* six times a year; *Bulletin,* quarterly; other publications.

FOREST FARMERS ASSOCIATION COOPERATIVE, 1100 Crescent Avenue, N.E., Box 7284, Station C, Atlanta, Ga.

History: Organized 1941.

Purpose: A non-profit organization of timber land owners—primarily small owners—in 15 Southern States, organized to give private timber owners and related interests a greater voice in matters affecting their business.

Publications: *Forest Farmer,* monthly.

FOREST PRODUCTS RESEARCH SOCIETY, 417 North Walnut Street, Madison, Wis. 53705.

History: Organized January 3, 1947.

Purpose: To promote the interchange of information among individuals and organizations interested in forest products research, development, production, distribution, and utilization.

Total Membership: 4,200

Publications: *Forest Products Journal,* monthly.

INSTITUTE OF ENVIRONMENTAL SCIENCES, 34 South Main Street, Mt. Prospect, Ill. 60057.

History: Merger of Institute of Environmental Engineers and Society of Environmental Engineers in April 1959 resulted in Institute of Environmental Sciences.

Purpose: To provide means whereby environmental sciences can be explained, discussed, and debated, and thus aid the technological advances of this hemisphere.

Total Membership: 1,900

Publications: *Journal of Environmental Sciences,* bimonthly; *Proceedings,* annual.

INDUSTRIAL FORESTRY ASSOCIATION, 1410 S.W. Morrison Street, Portland, Oreg. 97205.

History: Organized 1934.

Purpose: To promote forestry on both private and public lands throughout the Douglas fir region of western Oregon and western Washington. Founded Tree Farm movement in United States in 1941 and sponsors it throughout region.

NATIONAL FIRE PROTECTION ASSOCIATION, 60 Batterymarch Street, Boston, Mass. 02110.

History: Organized 1896; the Electrical Committee of the Association took over in 1911 the work of the National Conference on Standard Electrical Rules, dating from 1897; the Safety to Life Committee was organized in 1912; Marine Committee, 1922; Fire Marshals Protective Association of North America, dating from 1909, became a section of this Association in 1927; the Aviation Committee was organized in 1928; Society of Fire Protection Engineers was organized as a section of this Association in 1950; the Railroad section was re-established 1963.

Purpose: To promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects, and to secure cooperation of members in establishing proper safeguards against loss of life and property by fire.

Total Membership: 21,000

Publications: *Advance Reports,* annual; *Proceedings,* annual; *National Fire Codes,* annual; *Annual Fire Protection Handbook;* 600 other publications (catalog on request).

NATIONAL RECREATION AND PARK ASSOCIATION, 1700 Pennsylvania Avenue, N.W., Washington, D.C. 20003.

History: Organized 1898; reorganized to American Institute of Park Executives 1921; incorporated 1925; reorganized in 1966 by the merger of the American Associaton of Zoological Parks and Aquariums, American Institute of Park Executives, American Recreation Society, the National Association of State Park Directors, and the National Recreation Association.

Purpose: The National Recreation and Park Association is an independent, non-profit, service organization dedicated to the advancement and enhancement of the park and recreation movement and to the conservation of natural and human resources.

Total Membership: 10,500

Publications: *Parks and Recreation,* monthly; *Management Aids Bulletin,* monthly; *Recreation and Park Yearbook; Park Practice Program,* variable series.

NATIONAL SHADE TREE CONFERENCE, 1827 Neil Avenue, Columbus, Ohio 43210.

History: Founded 1924.

Purpose: To promote and improve the practice of arboriculture and to develop a greater public appreciation of the value of arboricultural practices.

Total Membership: 1,850

Publications: *Arborists News,* monthly; *Proceedings,* annual; various irregular publications.

NATIONAL WILDLIFE FEDERATION, 1412 16th Street, NW., Washington, D.C. 20036.

History: Organized 1936; formally chartered 1937; incorporated in the District of Columbia.

Purpose: To federate on a national scale state-level organizations expressing an interest in the conservation of wildlife and other natural resources and representing a cross-section of conservation interests within the States.

Total Membership: 2,000,000

Publications: *Conservation News,* bi-weekly; *Conservation Report,* weekly.

NATURAL RESOURCES COUNCIL OF AMERICA, 320 Bond Building, Washington, D.C. 20005.

History: Organized October 26, 1946.

Purpose: To advance attainment of sound natural resource management through an organization of major national and regional conservation and scientific societies by effecting cooperation among them to serve common needs in resource management.

Total Membership: 40 regional and scientific societies

Publications: *Legislative News Service,* semi-monthly.

(THE) NATURE CONSERVANCY, 2039 K Street, NW., Washington, D.C. 20006.

History: Organized in 1917 as Committee for the Preservation of Natural Conditions, under the Ecological Society of America; as Ecologists Union in 1946; under present title in 1950. Incorporated 1951 in the District of Columbia.

Purpose: To preserve wild nature, particularly to establish and protect nature preserves which will include an adequate series of natural areas of all types; to promote scientific, educational, and inspirational use of such areas.

Total Membership: 7,000

Publications: *The Nature Conservancy News,* quarterly.

NORTH AMERICAN WILDLIFE FOUNDATION, INC., 709 Wire Building, Washington 5, D.C.

History: Organized under a charter granted by the District of Columbia, July 22, 1935, as American Wildlife Institute; renamed American Wildlife Foundation, Inc., in 1946; present name adopted February 1951.

Purpose: To attain better management of natural resources, to encourage and perpetuate training of technicians and administrators, to advance public education and knowledge, to promote necessary research and its applications, and to effect better use of funds in the fields of restoration and conservation.

NORTHEASTERN LOGGERS ASSOCIATION, INC., Old Forge, N.Y. 13420.

History: Organized 1952; board of directors includes representatives of paper and lumber industries, U.S.D.A. Forest Service, State forestry departments, forestry colleges, and loggers.

Purpose: To promote profitable utilization of low grade wood and wood wastes in the interest of forestry.

Total Membership: 700

Publications: *Northern Logger,* special wood utilization issues, semi-annual.

RESOURCES FOR THE FUTURE, INC., 1755 Massachusetts Avenue, N.W., Washington, D.C. 20036.

History: Organized 1952.

Purpose: To advance the development, conservation, and use of natural resources through programs of research and education.

SOCIETY OF AMERICAN FORESTERS, Suite 300, 1010 16th Street, NW., Washington, D.C. 20036.

History: Organized November 1900.

Purpose: To represent, advance, and protect the interests and standards of the profession of forestry; to provide a medium for exchange of professional thought; and to promote the science, practice, and standards of forestry at an accredited college or university.

Total Membership: 15,500

Publications: *Journal of Forestry,* monthly; *Forest Science,* quarterly.

SOCIETY OF WOOD SCIENCE AND TECHNOL-

OGY, Colorado State University, College of Forestry, Fort Collins, Colo. 80521.

History: Organized as American Institute of Wood Engineering in June 1958 at Madison Wisc.; name changed to present title in 1959.

Purpose: To establish a professional basis for the pursuit of wood science and technology, to foster improvements in education in wood science and technology, to promote research in this field, and to provide a medium for exchange of ideas and technical information relating to wood science and technology.

Total Membership: 200

Publications: Intermittent.

SOIL SCIENCE SOCIETY OF AMERICA, 677 South Segoe Road, Madison, Wisc. 53711.

History: Organized 1936; incorporated in Wisconsin 1952; member, American Society of Agronomy.

Purpose: To foster all phases of fundamental and applied soil science.

Total Membership: 2,900

Publications: *Proceedings*, bi-monthly.

SOIL CONSERVATION SOCIETY OF AMERICA, INC., 7515 NE. Ankeny Road, Ankeny, Iowa 50021.

History: Founded 1941; incorporated 1949.

Purpose: To advance the science and art of good land use.

Total Membership: 11,141

Publications: *Journal of Soil and Water Conservation*, bi-monthly.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, 360 Lexington Avenue, New York, N.Y. 10017.

History: Founded 1915.

Purpose: To promote research, education, and application of the sciences in the pulp and paper industry, and the collection and dissemination of technical data fundamental to pulp and paper manufacture and use.

Total Membership: 11,210

Publications: *Tappi*, monthly; *Yearbook; Bibliography of Paper Making*, annual.

WILDLIFE MANAGEMENT INSTITUTE, 700 Wire Building, Washington, D.C. 20005.

History: Incorporated in the State of New York, May 8, 1946.

Purpose: To promote research and scientific activities in wildlife restoration, conservation, and management, including maintenance of research projects; to develop new and improved techniques, and demonstrate their use for the guidance of others; to gather basic technology and disseminate it by publications and publicity of all kinds and by personal contacts, through its field representatives; to provide contacts and maintain advisory consulting services; to promote and encourage education.

Total Membership: 674

Publications: *Transactions*, annual; *Outdoor News Bulletin*, bi-weekly.

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